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Thirty-five years of oil transport

James Dodds Henry

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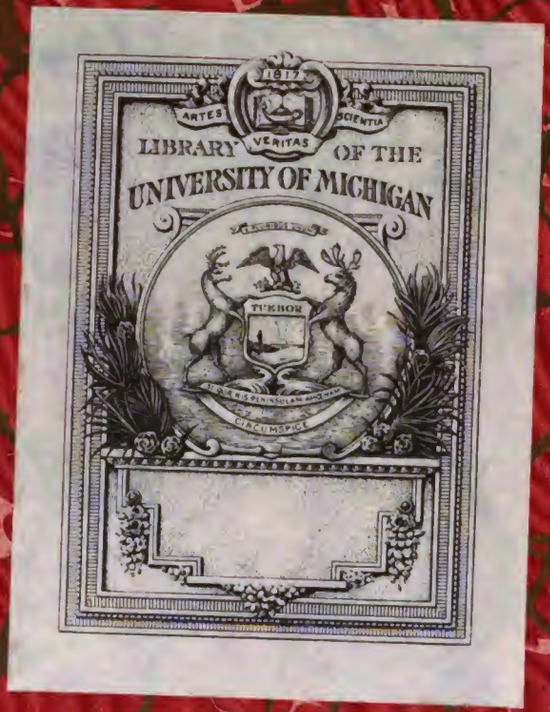

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R. McQuillan.

THIRTY-FIVE YEARS OF OIL TRANSPORT; THE EVOLUTION OF THE TANK STEAMER.

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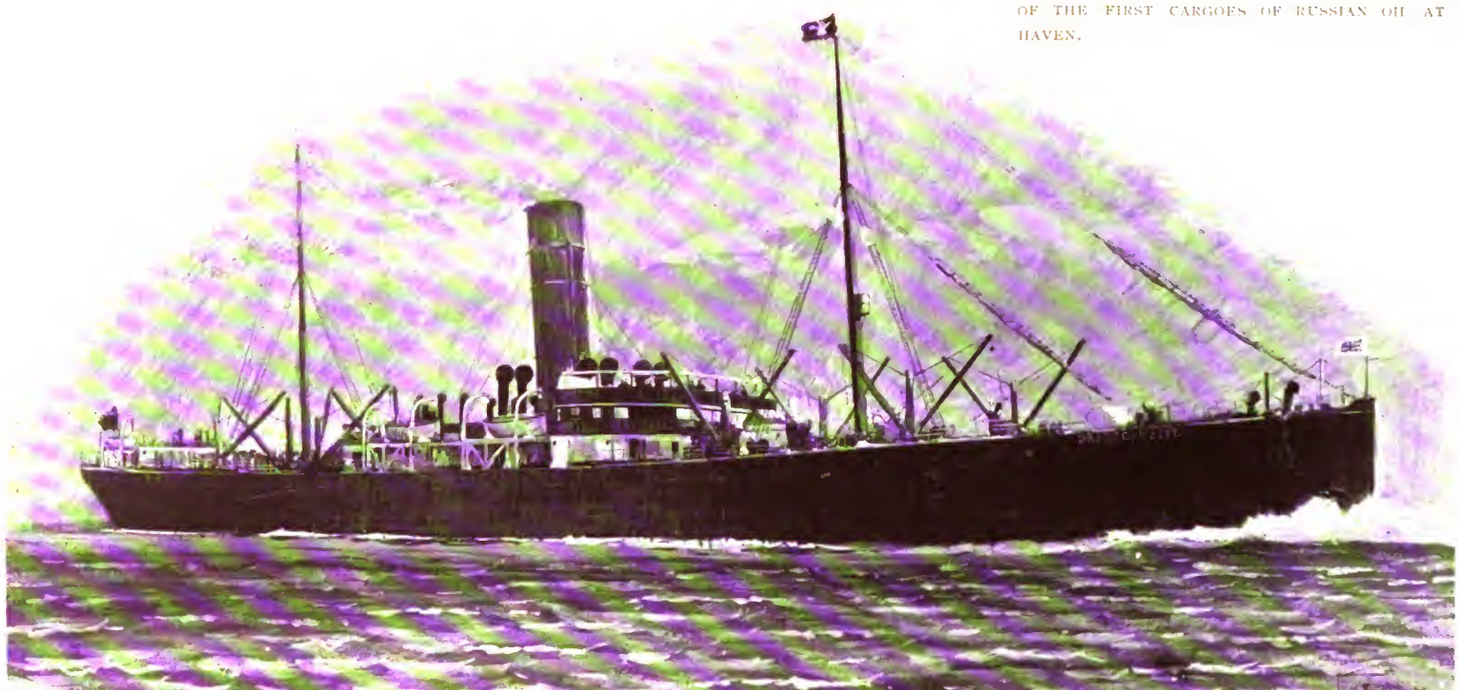
THE *LUDWIG NOBEL* (1887), AND *NARRAGANSETT* (1903).

THE *LUDWIG NOBEL* (EX. *PETROLEA*) DISCHARGING ONE OF THE FIRST CARGOES OF RUSSIAN OIL AT THAMES HAVEN.



THE *NARRAGANSETT*, THE LARGEST TANK STEAMER IN THE WORLD, OWNED BY THE ANGLO-AMERICAN OIL COMPANY, LTD.

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THIRTY-FIVE YEARS OF OIL TRANSPORT;

THE EVOLUTION OF THE TANK STEAMER.

BEING A HISTORY OF OLD AND NEW METHODS OF SEA AND RIVER TRANSPORT OF PETROLEUM AND A SEMI-TECHNICAL DESCRIPTION OF THE CONSTRUCTION OF TYPICAL TANK STEAMERS, WITH INCIDENTAL NOTES ON THE PRODUCING AND COMMERCIAL BRANCHES OF THE INDUSTRY, STATISTICS AND A LIST OF THE OCEAN-GOING OIL-CARRYING VESSELS OF THE WORLD.

BY

J. D. HENRY

(*Editor of "The Petroleum World," Author of "Baku: An Eventful History," &c.*).

NUMEROUS HALF-TONE ILLUSTRATIONS, DIAGRAMS AND SECTIONS.

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TO SHIPMASTERS WHO HOLD, OR HAVE HELD, COMMANDS IN THE WORLD'S OIL-CARRYING VESSELS
(Sail and Steam),

In acknowledgment of the Skill, and, in some cases, the Personal Bravery they have displayed in a Business which calls for exceptional Seamanship and Nerve,

This Work is

DEDICATED

By THE AUTHOR, whose nautical experiences off the British coast, in the Gulf of Mexico, and on the Caspian Sea are amongst the most pleasant of a long and varied professional career.

(See p. 105.)

(From a Photo taken for this work.)
MR. S. GOULICHAMBAROFF,
OF ST. PETERSBURG.

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PREFACE.

By Mr. S. GOULICHAMBAROFF. Conseiller d'Etat Actuel de S.M. l'Empereur de la Russie. Fonctionnaire pour missions spéciales auprès du Ministre du Commerce et de l'Industrie.

AM not yet acquainted with your new work, but your knowledge of the history and conditions of all branches of the petroleum industry, your ability as an author, and your editorial work, which, by its variety and character, has done much to unite petroleum producers in all parts of the world, convince me that it will enrich the literature of petroleum, and especially the literature of the marine branch of the industry, which, I consider, needs it the most.

¶ I comply with your request all the more readily because I happened to be at Baku in 1876, when the great idea of the transport of petroleum and its products in bulk was first conceived. I was a witness of its inception, and have followed its rapid growth and final development with the keenest interest. I consider the successful solution of this problem of transport to be the most important fact in the entire history of the petroleum industry, as, owing to historical and geographical conditions, the huge business of the exploitation of the petroleum fields is chiefly concentrated at the two antipodes of the world—the United States and Russia, while the two greatest consumers of petroleum—Great Britain and the Continent of Europe—are in the centre.

¶ A great problem of the early days of the industry was the bringing of the producer and the consumer, separated by the Atlantic, Pacific and the Indian Oceans, nearer to each other. The successful solution of this difficult problem was entirely due to Ludwig Nobel, brother of Alfred Nobel, who has immortalised himself not only in the technical but in the whole of the civilised world ; he has done this by sacrificing great capital in the way of premiums to the most important inventors in the different branches of science—to all, in fact, regardless of nationality and place of activity. These two brothers, having left their Fatherland (Sweden), chose as an arena for their activity—Ludwig, Russia ; and Alfred, France. Need I say that both of these countries should be proud of the brilliant and eminent children of their adoption.

¶ The principal motive which prompted the idea of the bulk transport of petroleum products was the remoteness of the Baku oil fields from the foreign and home markets. Thirty years ago Baku was not connected by rail with the Black Sea, and the only outlet for the petroleum products was the port of Baku (and then only in the summer), whence the goods went by the Caspian Sea to Astrakhan and up the Volga, there to be distributed in the interior markets or sent abroad.

¶ As the liquid cargoes had to travel so far the tare question became one of considerable importance. The petroleum had to be transported in wooden barrels, and as there was no timber or any other suitable material near Baku the staves had to be brought from remote parts of Russia, over the Caspian Sea, and were, therefore, very expensive. The tare amounted to about half of the cost of the petroleum ; a barrel of 6–7 English centners cost about £1, *i.e.*, about three shillings per centner. The heavy expense could only be met in cases where costly goods were transported, but as, owing to the rapid development of the production, and with a total absence of export, the price on oil began to diminish (during the period 1873—1875 the price fell from three shillings per centner to one penny), it was most important to find means of cheapening the tare.

¶ At the very outset of his career in this industry L. Nobel came into contact with this important question. As the price of crude was as low as one penny per centner, it was impracticable, of course, to

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pay three shillings for the tare, and, therefore, quite impossible to export such goods from Baku.

¶ The transport of petroleum residuum was in a still worse condition. This residuum was quite worthless at that time, as everyone did not know how to use it as fuel, and owing to its worthlessness L. Nobel made the experiment of loading it in a wooden barge and transporting it to Astrakhan at the risk of losing great quantities through leakage. This experiment proved that the leakage was not so great as might have been expected, whereas the advantages of the new mode of transport were immense; it was cheap, and likewise convenient, as the cargo of the barge was easily pumped in and out. The results were so convincing that many of the oil men followed L. Nobel's example, but it was too obvious that this method of transport could only be adopted in the case of cheap cargoes.

¶ L. Nobel had to work hard and spend a great deal of money on numberless experiments, which did not all prove successful, in order to make the system adaptable to the transport of more valuable cargoes. At last, in 1878, the first steamer adapted for the transport of the valuable products of petroleum without tare was constructed. At the beginning the oil was poured into iron reservoirs fixed in the steamer, and, later on, straight into the hull of the vessel itself.

¶ Examples are always more convincing than theory, and many availed themselves gratuitously of the costly lesson given by L. Nobel. At first the schooners and barges were constructed only for the Caspian Sea, but soon they also appeared on the Volga, and, later on, the idea of carrying petroleum in bulk spread beyond the limits of Russia and found everywhere favourable fields for a vast development. Thus the fruitful seed sown by the genius of Nobel in Russian soil, thirty years ago, brought forth a brilliant harvest in both hemispheres.

¶ In 1878 there was only one tank steamer, the *Zoroaster*, in the world's business of oil transport; in the following year there came a second, the *Buddah*, and then the construction of oil vessels went on rapidly, these two great names of antiquity being followed by a Pleiades of others, the pride of Mankind —*Bramah, Moses, The Saviour, Socrates, Mahomed, Spinosa, Darwin, etc.*

¶ The reports of the great advantages of carrying oil in bulk when compared with the old system of transport in casks spread rapidly abroad and attracted the attention of shipbuilders in other countries. During the period covered by this history of the industry the world's bulk oil-carrying fleet, according to one authority, has increased to 276 vessels, of which 237 are steam and 39 sailing vessels,* but it seems that there are many more, and Lloyd's list is obviously not complete. On the Caspian alone there are nearly 150 tank steamers.

¶ The first oil steamers were built in Swedish shipyards, and, later, their construction was carried on at Russian, Finnish, English, German, American and other centres. Each shipyard tried to introduce some new improvement into the construction of these vessels, although they all kept to the type originally introduced by Nobel. The English and Swedish vessels are famous for their strength and the high quality of the material used, while the German vessels compete successfully with the English and the Swedish owing to the cheap price at which they are sold.

¶ The following table shows the development of the Russian steam and sailing oil fleets on the Caspian Sea for the period of thirty years (1878—1907) :—

Years.	Steam Vessels.		Sailing Vessels.		Total.	
	No.	Tonnage (cub. ft.).	No.	Tonnage (cub. ft.).	No.	Tonnage (cub. ft.).
1878	1	15,610				
1879	2	37,660				
1880	4	96,545				
1881	9	228,456				
1882	11	319,200				
1883	18	534,600				
1884	25	700,500				
1885	25	700,500				
1886	25	700,500				
1887	26	721,400				
1888	30	808,000				
1889	40	1,112,800				
1890	44	1,240,000				
1891	54	1,578,900				
1892	58	1,720,825				
1893	59	1,758,463				
1894	66	1,992,947				
1895	87	2,728,217				
1896	92	2,942,327				
1897	93	2,998,447				
1898	112	3,814,746				
1899	129	4,616,702				
1900	134	4,884,692	212	3,822,756	346	8,707,448
1901	126	4,690,312	156	2,915,859	282	7,606,171
1902	126	4,753,658	157	2,955,968	285	7,609,626
1903	127	4,917,259	155	2,971,430	282	7,888,689
1904	134	5,328,094	153	2,970,428	287	8,298,522
1905	132	5,252,410	151	2,933,400	282	8,185,810
1906	131	5,294,714	149	2,886,800	280	8,181,594

¶ On January 1st, 1907, there were in all 136 oil-carrying (tank) steamers in Russia, with a tonnage of 90,455 register tons and a carrying capacity of 142,300 tons.

* *Lloyd's Register*, 1906-7.

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¶ These steamers are distributed on the different seas in the following manner :—

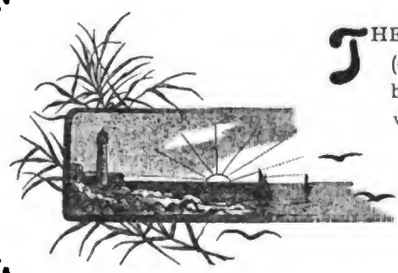
	No.	Net tonnage (in tons).	Carrying power (in tons).
Baltic Sea	2	990	1,730
Black and Azov Seas	6	7,558	15,344
Caspian Sea	128	81,907	125,262
Total	136	90,455	142,336

¶ There were 166 tank sailers on the Caspian Sea on January 1st, 1907, with a tonnage of 48,975 register tons.

¶ The vessels carrying petroleum in bulk in Russia numbered 302, with 139,430 tons register.

¶ These few facts do little more than indicate that the subject is one of immense interest, and I can only express the hope that this history of an important branch of the industry will bring to light many things which are not now generally known to oil men in different parts of the world.

S. GOULICHAMBAROFF.



THERE are, territorially, few points of contact (only limited railway and pipe line connections) between the widely scattered oil fields of the world, and we must necessarily always depend on our oil-carrying vessels to maintain the system of inter-communication between the oil ports and the chief refining and distributing centres.

J. D. H.

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PART II.

SOME OIL PORTS, WITH A SPECIAL CHAPTER ON OIL PORTS IN THE MAKING, BEING A DESCRIPTION OF THE LATEST OIL FIELD DEVELOPMENTS IN BRITISH COLONIES.

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ILLUSTRATIONS.

PLATES.

TWO-PAGE SUPPLEMENTS.

PRINCIPAL SECTIONS.

MAPS.

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PART I.

THE WORLD'S OIL-CARRYING FLEETS:

HISTORICAL AND DESCRIPTIVE.

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INTRODUCTORY.

Being the Author's Explanation of the Aims and Scope of this Work, with some General Opinions on the Present Day Position of the Petroleum Industry.

EADERS of this work will probably agree that no one connected with the literature or the industry of petroleum could undertake a more interesting task than the one on which I have been so earnestly engaged for many months. The marine transport of petroleum has in it that which should produce, if not the most romantic and sensational, certainly one of the brightest and most fascinating chapters of oil world history. By the employment of the almost unique facilities I enjoy for the collection of historical data, hard facts, and statistics in all parts of the world, I have sought to produce a readable and reliable history of the progress of the transport systems of the industry, with a semi-technical description of the evolution of the tank steamer as a chief feature.

¶ Although the subject is obviously one of immense importance, full of life and movement, and having an element of ocean-created romance, it has been neglected to such an extent that I should say the published information suitable for this history could very well be compressed into a page of the *Times*. This is fair evidence of an opening for a work of this kind. On the point of whether I am correct in my conjecture that this is the proper time to publish this book, I can only say that the oil-carriers are this year getting unheard-of freights, that they are amongst the most profitable vessels in the mercantile marine of any country, and that the demand for new tonnage is greater than it has ever been since some of the pioneer tank steamers cleared themselves by the trips of a single year.

¶ This is quite a remarkable year for oil-carrying shipping and ship-building, one of unparalleled prosperity—the best, in fact, in the history of the industry, if it is looked at from the point of view of all concerned and not from the narrow standpoint of the few who, fifteen and twenty years ago, had certain selfish reasons—monetary ones, to be plain—for considering it one of the most exclusive and mysterious of the world's business monopolies.

¶ My interest in the history of the industry and great faith in its future growth, reputation and usefulness give me the assurance that this work will be favourably received, both as a record of what has been achieved and an up-to-date and important description of the considerable changes which are taking place in the methods and commerce of oil transport in all parts of the world.

¶ A bright future for the industry is assured. Exactly why this is the general feeling of oil men to-day is scarcely a fit subject for this work, which, the title shows, has very little to do with the finance of oil or oil field history and events; but, writing generally, let me repeat what I recently said elsewhere that, having regard to the remarkably steady expansion of the oil fields, oil ports, and refinery regions, and the irresistible growth of petroleum as a cheap, efficient and portable light and fuel—transported by land and sea to the four quarters of the globe—the day is imaginable when we will have steamers of still greater tonnage (some of them working with twin screws and towing ocean-going barges of 10,000 tons), when oil storage installations will be as common as coal depôts on the lines of ocean traffic, and when there will be no port near a centre of distribution that will not be in direct touch with the chief sources of supply.

¶ The light that is needed everywhere, petrol that is becoming one of the greatest needs of the world's huge motor industry, and the improvement of the engineering and scientific methods of utilisation all make for that consumption which ensures for us a greater and better world of oil.

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¶ A quarter of a century ago the largest deposits were found in territories at the base of, and parallel with, ranges of mountains. The oil fields of America lay west of the Allegheny Mountains, those of the Pacific coast west of the great ranges which fringe the Pacific Ocean, while those of Southern Russia lay close to the Caucasian range of mountains.

¶ The old-time theories of experts have been upset by the discoveries of recent years. The sun-scorched and bare prairie, the almost impenetrable and swampy parts of uncivilised lands, the ice-locked wastes of Northern Canada and Russia are all possible sources of supply which will be certain to attract the notice of the men who will drill for oil in the next generation. Oil is found in unexpected places, often beneath a surface that is absolutely barren of indications, and where the modern drill alone can be depended upon to give us the truth. Petroleum pessimists no longer declare that the oil world is shrinking; rather have we reached a time when the oil men of the world, with a greater hope and an increased faith in the industry, may conscientiously contend that the sources of our future supply will prove illimitable. I believe the production of petroleum will increase 50 per cent. during the next ten years, and to me it will be a matter for regret if the oil interests of the Empire do not extend in proportion, nay, increase out of all ratio, with the progress and prosperity of foreign countries.

¶ The oil men of the world will make a fatal mistake if they fail to appreciate the immense scope there is for oil field expansion, or if, in the huge refinery section, they do not make the most of the facilities which exist for the early and rapid multiplication of the uses to which the numerous products of petroleum can be devoted. After all, there are few countries which are barren of oil; no matter in what form we evolve artificial light we depend upon it, and wherever there is civilised commerce it is one of the standards of trade.

¶ Although we find oil in almost every country, everywhere, in fact (an allusion to its use and not to its production), I am with those who believe that the greatest oil sources are still hidden beneath the earth's crust, and it is these unexplored territories which will, as the result of the bright and never-dying hope and hard toil of thousands of oil men, and the employment of almost untold wealth, be the oil fields of the future—greater than even the prolific territories of Bibi-Eibat and Balakhani, which to-day stand as records, not only for the Caucasus, but for the world.*

¶ The geography of the petroleum world is no longer confined to the two first great centres of production — Baku and the northern fields of America; the sun never sets on the oil world, which, territorially, is greater than ever, and I am not surprised that many oil men are displaying an increasing amount of faith in the steady multiplication of the sources of supply.

¶ In the preface which he has done me the honour of writing, Mr. Goulichambaroff† gives an interesting summary of the history of marine oil transport in Russia, and I am pleased indeed that he has thought it well to refer to one story which oil men the world o'er never tire of reading—I mean the one of the struggles and triumphs of the Nobels. Of the Nobels I wrote in my book "Baku":—

¶ "Only a man of rare and remarkable talents could have done what Nobel achieved, and we

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* The marvellous oil fields of Russia, although they were swept almost from end to end by fire two years ago and are to-day being seriously damaged by the fierce fights of capital and labour, have not yet been eclipsed by the oil fields of any other country; in the matter of possible production they retain practically the same position which they occupied twenty-five years ago (1882) when Prof. Mendelieff put this opinion on record:—"Comparing results achieved in the two countries (Russia and America) on one side and the average depth and total number of wells on the other, it may justly be stated that the natural petroleum wells of Baku, as far as our knowledge goes, have no parallel in the world."

† Mr. Goulichambaroff has written in the Russian language numerous works on petroleum subjects, and if these were translated into English they would constitute, in the aggregate, by far the most important individual contribution to the literature of oil. He was the pioneer of petroleum authorship, and I have been surprised at the frequency with which Charles Marvin and later writers turned to his Russian records for much of their best and most reliable information. A conscientious statistician, a far-sighted and thoroughly practical expert, and an unostentatious official of the Russian Office of Trade and Industry, the uncopyrighted results of his research work and original discoveries in Russia and other parts of the oil world have always been at the disposal of those who have sought to disseminate information likely to be of service to the industry. This is the first occasion on which he has written the preface for a work by a foreign author, and I put this fact on record with pride and satisfaction because he was the first historian of the modernised petroleum industry, and is to-day one of the highest official authorities on oil pipe line and marine transport subjects.

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are Anglo-Saxon enough to say that the written eulogies of the Nobels are none the less deserved because they were Swedes working in a country where many of our enterprises have been such disastrous failures that they have brought British methods and ability perilously near to disrepute. . . . To-day the great founders have been gathered to their fathers, but the company lives, worked by men who, employing genius and honesty, keep it in premier position, and make it the popular leader in all movements for the improvement and, in the present crisis, for the reconstruction of the industry at Baku."

¶ Mr. Goulichambaroff having done justice to Russia, I feel that I am free to devote a little attention in this introductory chapter to facts relating to other parts of the oil world.

¶ Baku, with its huge yield of oil, until three years ago half of the world's production, and its dangerous oil field life; the old Campina and Bustenari territories, which have done so much to establish the reputation of Roumania as an oil-producing country; Boryslaw, which, during three years of unparalleled prosperity, threw into the shade and starved the Schodnica and other still more ancient oil fields of Galicia; the famous Eastern fields of America, in which 150,000 wells have been drilled; and California, Kansas, and other States, each with its substantial contribution to the world's annual output of 28,076,297 tons, have added their chapters to the history of an industry to which I cannot pretend to do literary justice, and in which we find the records of so much true genius, that perseverance which almost inevitably leads to successful achievement, and, unfortunately, some of that mischievous misrepresentation and rascality which it is not humanly possible to eliminate from the struggle to reveal the mysteries of the earth's mineral wealth and extend the commerce of petroleum in all parts of the civilised world.

¶ There is no oil field that is barren of romance, and those I have mentioned, and others too, have histories to which adequate justice cannot be done by the historian, I care not how clever he may be in the manipulation and condensation of the stories of the terrible realism and hard facts which spring from the diversified existence of the men who drill for oil in so many different lands.

¶ In "Baku" I have described a series of the most awful tragedies recorded in the annals of any industry; but into this work—a serious study of the history and problems of our systems of transport—I cannot be expected to weave any of the romantic stories of those early times when oil, released by the steam-driven drill and the pent-up energy of geological ages, burst through the subterranean rocks, created cities, and gave oil men a huge industry and mankind a cheap light. I have done the best I could with the space at my disposal.

¶ One instinctively turns from Russia to America, its old-time and present-day rival, with its marvellous systems of production, refining and transport, and those statistics which never fail to appeal to the imagination and show us what great wealth and ability are employed to maintain the progress and status of industry in the Western Hemisphere.

¶ The following statistics (totals which have been specially collected for this work) illustrate better than anything I could write the complete revolution which has taken place in the methods of American ocean transportation of oil to Europe, and the growth of commerce partly traceable thereto—

	In Barrels. In American (not Imperial), gallons.	In Bulk.	Total
1885 ...	200,600,000	1,750,000	202,350,000
1906 ...	1,750,000	484,750,000	486,500,000

¶ I know of no statistics in oil transport—and I have certainly not come across any while at work on this book—that will compare with these in providing simple and forcible proof of the marvellous growth of the bulk oil system of transport.

¶ The Standard Oil Company* owns or controls a fleet of sixty tank steamers with a combined capacity of 1,700,000 barrels (71,400,000 gallons), twelve tank steamers and coasting barges with a combined capacity of 260,000 barrels, five cargo (case oil) steamers with a combined capacity of 760,000 cases (7,600,000 gallons), and nineteen sailing vessels capable of carrying 2,100,000 cases. In addition to giving full employment to its own fleet, the company chartered in 1906 tank steamers to carry 57 cargoes in bulk, ordinary steamers to carry 94 cargoes of case oil, and other vessels to carry 50 cargoes of case oil. The company owns the largest quantity of oil-carrying sail tonnage, and has added to its many pioneering records the one of having been the first to show the world what can be done in ocean oil transit in barges.

¶ The history of the Standard is that of a flowing tide; its onward movement has been constant; and its achievements claim for it a conspicuous position in the history of any branch of this industry.

¶ I also devote space to the history and work of

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* The shipping department is managed by Mr. Philip Ruprecht.

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other leading oil transport companies in America and Russia; I have likewise included lengthy references to the Anglo-American Oil Company, the old-established firm of Messrs. Lane & Macandrew, and a number of others, not overlooking, of course, the conspicuous claims which the old Shell Transport and Trading Company must always have on anyone who undertakes to record petroleum history. Here I should like to say that, notwithstanding the developments of the past twelve months, I have endeavoured to do justice to the reputation and record of the last-mentioned company. If I were asked to indicate the chief characteristics of its earliest methods of business I would say that first came its boldly displayed independence and then that indomitable perseverance which, if it has not ended in absolutely successful achievement, has resulted in the extension of a great idea: the one of liquid fuel. The Shell has excelled all other companies in the practical advocacy of the steam-raising qualities of oil fuel, and it is a matter for sincere regret that the consummation of the ideas of the founder and head was not witnessed during the days of his company's independence.*

¶ The creation of the Shell fleet will always stand as a splendid exhibition of British shipping enterprise, although to many in this country the fact that some of its most successful steamers now fly other house flags must be a matter for very sincere regret.

¶ I also devote attention to the following subjects for the reasons which are given in parentheses—

¶ *The Oil Fields of Texas* (because of their remarkably rapid development and their recent connection by pipe line with the once isolated and widely-scattered territories of the Mid-Continent region†),

¶ *British Colonial Oil Field Exploitation* (because I am convinced that the Colonies will produce the great oil fields of to-morrow, a statement which specially applies to Trinidad and Nigeria),

¶ *The Transport of Oil through the Suez Canal* (because no full and authentic history of the negotiations for the opening of the Canal for petroleum traffic has been published; the deep interest which is taken to-day in the experimental stages of traffic in benzine in bulk; and the serious mishaps to the tank steamers *Lucifer*, *Silverlip* and *Sophie*), and

¶ *This Year's Additions to the Oil-Carrying Fleets of the World* (because I find myself able to give information which has not appeared in any paper or work on oil).

¶ The reader will also find in the lengthy chapters on the building of tank steamers references to the quality of the work, and no doubt the opinion he will form will be this—that although some inferior vessels have been placed in the trade, English builders can produce the best steamers, provided owners are prepared to pay the price for the best work.

¶ There is also the subject of oil shipping disasters. Here I am in agreement with Mr. George Herbert Little, who wrote so ably on the marine transport of petroleum nearly twenty years ago, when he pointed out that petroleum is not more dangerous than any other cargo provided common sense and intelligence are used by those who handle it. It is just as true now, as it was in his day, that every explosion has been due to the neglect of those precautions which a slight knowledge of petroleum would suggest to persons of ordinary intelligence. For the proper transport of petroleum it is absolutely necessary that the masters and officers of tank steamers should possess a knowledge of the elementary principles of its chemistry, combustion and safe handling under all the varying climatic and engineering conditions of long voyages in different seas, and it is satisfactory to know that many of those who have command of oil-carrying steamers to-day are, in actual practice, real experts in their business. Even to these men of experience I hope this work will be of some interest, if not of real service, for I have a very sincere admiration for shipmasters and their most arduous and honourable profession.

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* The Company has combined with the Royal Dutch.

† Nothing I have read in oil field history, or, indeed, in the history of any mining industry, will compare with the marvellous expansion of the oil regions which now extend from Pennsylvania down to the Gulf of Mexico. Thirty-five years ago, when the Parker territory went down into oblivion, the wells of McKean County started to flow; then, to the West, there were the fields of Indiana, stretching on to Illinois, across the Mississippi and right into the heart of the Mid-Continent territory, where we now have the pipe lines to take the oil through to tide-water at the Gulf.

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CHAPTER I.

Early Days of Oil Transport. From the Sailing Ship Era to the First Tank Steamer.

THE Anglo-American business was quietly started in 1860, when an enterprising Pittsburger brought American petroleum in homeopathic quantities to this country. That was one year after Colonel Drake drilled the famous pioneer oil well at Titusville, Pennsylvania,* when oil was selling at four shillings a barrel, nineteen years before Roumania started to export oil, and twenty-six years before the first cargo of Russian petroleum was shipped from Batoum to this country.

Mr. James Young, the first inventor of paraffin oil patents (1849), following on the lines of Mr. Luther Attwood, a chemist, began the manufacture of mineral oil for illuminating purposes in this country. It had a large sale and Mr. Young made a great fortune.

Mr. Attwood took a gallon of Mr. Young's oil to America, where he expressed the opinion "that it was one of the most beautiful oils for illuminating purposes he had ever seen or thought it possible to produce."

Mr. Young, in 1860, followed this sample of his oil across the Atlantic. He had a penny a gallon royalty for whatever crude oil his American agents produced from shale. In 1861 he made his second journey to America, and visited the oil fields in the Titusville region. Asked what he thought about developments at Oil Creek, he answered, in broad Scotch, "I dinna think it will amount to mooch; it is ephemeral and won't last; it won't last." He added, "We had a lot of petroleum from the Derbyshire mines in England when I first began, but it was in pockets and limited in quantity."

These two industries, shale oil in Great Britain and mineral oil in America, started simultaneously. They met a need of the times. The annual catch of whales was growing smaller as the chase grew longer, the world was being ransacked for animal and vegetable fats, and a famine of lubricating materials was a serious problem which had to be faced by those who were responsible for the management of the railways and steamship lines.†

Westward, Philadelphia pioneered the business of ocean oil transit between America and this country. In 1861 a five-barrel invoice was despatched, and a few cases and barrels were shipped on general cargo vessels, but they were merely samples. On November 12th of that year, Messrs. Peter Wright & Sons, Philadelphia, chartered from Messrs. Edmund A. Sander & Co. the brig *Elizabeth Watts* (224 tons), to load a cargo of oil in barrels for London at the rate of eight shillings per barrel and 5 per cent. primage. Very little is known about the trip. It took several weeks to load the little oil sailer, but when she was ready for sea the skipper could not get together a crew to work above a cargo of oil. Failing to engage sailors in the regular way, men were got aboard while under the influence of liquor, and she sailed down the Delaware River with a drunken crew. She got safely across the Atlantic, and landed her cargo in good condition at a London wharf.

This successful voyage led others into the business, and the records of the Philadelphia Commercial Exchange show that the shipments of

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* Pennsylvania has produced over 600,000,000 barrels of oil since Drake discovered this oil well on Oil Creek. The total oil production of the United States from 1859 to 1906 has exceeded 1,600,000,000 barrels, and no State has produced as much oil as Pennsylvania.

† As early as 1860, owing to the growing scarcity of whales in the high seas, there was a serious shortage in the supply of sperm or whale oil, and men were hard at work on the problem of supplying the world with a cheap, safe and efficient illuminant to take the place of the tallow candle, the greasy whale oil lamp, and the dangerous camphene and burning fluids which were then the sources of artificial light in general use.

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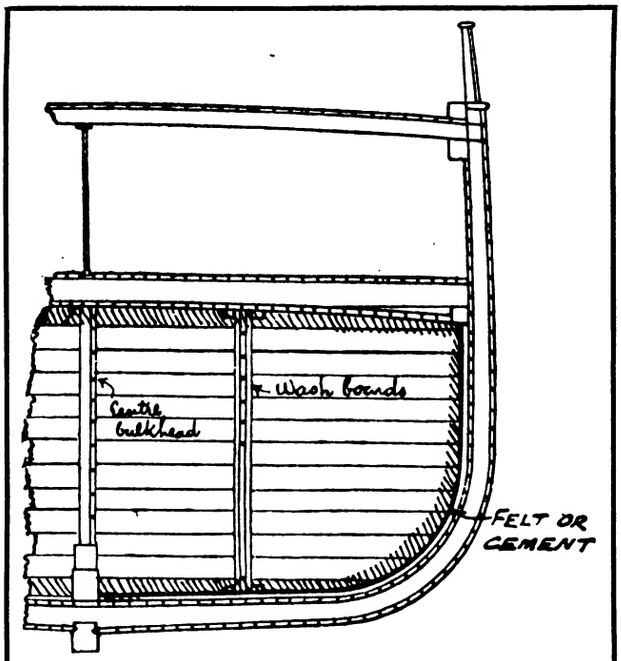
petroleum from the port for the next three years were :—

	Gallons.
1862	2,664,280
1863	4,680,174
1864	7,666,025

During 1864 the entire exports from all United States ports amounted to 31,745,687 gallons.

On August 1st, 1863, there was launched from the yard of Messrs. Rogerson, at St. Peter's (a place on the Tyne where small collier brigs were built), an iron sailing vessel named the *Atlantic*. She was designed to carry petroleum in bulk "without the aid of casks," and her owners (now unknown) intended



This section (drawn by Mr. H. Böcler) shows a type of the wooden sailing ships which carried oil in bulk about 1878. The holds themselves formed the tanks as shown above.

her to run in the Atlantic oil trade, which had started to attract the attention of shipowners in the North of England. Her hold was separated into compartments by sheet iron partitions. She was 148 ft. long, 28½ ft. beam, and 16 ft. 9 in. in depth.

Mr. Henry Duncan (Bromley, Kent) claims to have sent the first oil-carrying vessel to Europe by way of the Canadian Canals, the St. Lawrence, and the Atlantic. Some four years ago he told me that as far back as 1863 * he purchased a schooner at Chicago, loaded her with petroleum at Port Sarnia, on the River St. Clair, Canada, and despatched her to Liverpool. That she was lost in the Gulf of St. Lawrence, just as she was about to enter the Atlantic, in no way detracts from his claim to be the pioneer of American inter-lake and ocean navigation.

The *Atlantic*, obviously the most important of the two, was specially designed to carry oil in bulk and eclipse the barrel carriers then engaged in the Atlantic trade. Unfortunately, a diligent search for information on the Tyne and at the earliest of the oil ports has failed to bring to light anything reliable about her career, although the particulars of her launch, which I have from an unquestionable authority, prove her to have been the first British bulk oil vessel built to trade between America and this country.

The *Charles* was probably the first vessel fitted with iron tanks for the transport of petroleum. She was employed from 1869 to 1872 in carrying crude between the United States and Europe. Her capacity was 794 tons, and she was fitted with tanks arranged in rows at the bottom of her hold and in the 'tween decks—fifty-nine in all. She was worked on the separate tank system, and there were no pipe connections. There was no automatic arrangement for keeping the tanks full, but salt water was run into those which were found to leak during the voyage.

One of the most serious disasters to the early oil carriers occurred in the case of the ship *Joseph Fish*. How she was struck by lightning when crossing the Atlantic in 1876 is described in the chapter on casualties to oil-carrying vessels. One of the earliest of the wooden vessels placed in the oil trade was a small Baltic blockade runner, which was lost on the Goodwin Sands.

Every year up to 1878 wooden sailers were adapted to carry oil in bulk, the holds themselves forming the tanks, and occasionally a tramp steamer crossed with barrelled oil.

These tank sailers wiped out the barrel-carrying traders; they were larger, and the fact that they could be more economically worked enabled their owners to cut down the rate of freight.

The superiority of the bulk over the barrel system of transport may be gathered from the following calculations made by Mr. B. Martell, Chief Surveyor, Lloyd's, and embodied in his lecture before the Institution of Naval Architects,

* As early as 1863 oil was burned by the poorest inhabitants of Lebanon, Palestine, and in Syria, while ten years later nearly 1,000,000 gallons were sent to Syria from America.

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July 27th, 1886, and dealing with the earliest of the tank steamers:—

"A barrel weighs on an average 64 lbs., or one-fifth of the oil it contains, and to the uselessness of this weight must be added the space wasted in packing the barrels in the hold of a vessel. Thus a vessel capable of conveying 2,000 tons of cargo, and which, if fitted with tanks, would carry nearly that quantity of oil, would, if filled with barrelled oil, carry only 1,030 tons instead of 2,000 tons. Moreover, the importer has to pay 4*s.* 6*d.* or 5*s.* 6*d.* for each barrel at New York, and, with the exception of those sent back to America, they are sold in London when empty for from 3*s.* 6*d.* to 4*s.* each. The depreciation of from 1*s.* to 1*s.* 6*d.* in the value of the barrel, which amounts to as much as from £350 to £475 for one voyage, in the instance of the 2,000 ton vessel referred to, would be saved under the bulk system."

Another important advantage was the saving of time and labour. A tank steamer of 2,000 tons capacity could load or unload in ten hours, the operation only needing the supervision of the engineer and his assistants. A similar cargo, if barrelled, required a week to stow or unstow, and large gangs of men had to be constantly employed Moreover, when barrels were employed, the leakage was considerable, and in a large cargo constituted a serious item of loss. As to the objection sometimes raised that the early tank steamers had to make the return journey empty, it was naturally pointed out that vessels laden with empty barrels continually and regularly returned to America.* Altogether, therefore, the opinion of Lloyd's chief surveyor appeared to be thoroughly sound, that "whether regard be had to the amount of cargo carried, to the loss incurred in respect to the depreciation in the value of the barrels, or to the rapidity with which loading or unloading took place, the balance of economic advantages was clearly and overwhelmingly in favour of the carriage of petroleum in bulk."

I should mention that the system of carrying large quantities of liquids in bulk was employed in connection with wine and water twenty years before the first bulk oil carrier was sent to sea. For half a century in northern Italian ports small coasting vessels have carried wine in bulk. The wine, carried against the outer skin with nothing intervening, is discharged by small hand pumps into barrels or pitchers on the quays. The buoyancy of these small vessels is preserved by fitting wine-tight wooden bulkheads at the two ends.

The start of the tank steamer in this country was something of a mystery. Palmer & Co. of 1872 (now Palmer's Shipbuilding and Iron Company, of Jarrow-on-Tyne†) built the *Vaderland* (2,748 tons)

* As fully explained in later chapters, steamers now carry oil in one direction and general cargo in the other. This is accomplished by means of artificial ventilation, by perfectly cleansing the holds, and by removing every trace of the oil. Powerful fans keep up a continuous circulation of air through the holds. Steamers now carry oil from Batoum to the East, and bring back the most delicate products of Eastern manufacture, foods like rice, and even tea.

† Since this vessel was sent away from Jarrow about 150 tank steamers have been built on the Tyne. The shipbuilding towns lie in a cluster on both sides of the river; they are Jarrow, Walker, Wallsend, Hebburn and Howdon. Mr. Malcolm Dillon, General Manager of Palmer's Shipbuilding and Iron Company, says that, writing more than a century and a half ago, Defoe said: "They build ships here to perfection—I mean as to strength and firmness, and to bear the sea." Since this was written the Tyne has well maintained the reputation it possessed in the days of Defoe. The annual aggregate of vessels launched from her banks has exceeded 300,000 tons, equal to about one-fifth of the whole shipbuilding output of the United Kingdom. The genius of Lord Armstrong revolutionised modern ordnance, and Stephenson built and perfected the first locomotive which was destined to become so enormous a factor in human activity. Palmer's works are on the South bank of the river, seven miles from Newcastle and three from South Shields. The town derives its name from the Saxon word *Gyrwy* or *Gyrvy*, meaning a marsh or fen, and referring to an extensive pool on the east side, Jarrow Slake, where tank steamers frequently moor when in the river. Jarrow has about 40,000 inhabitants, mainly employed in, or dependent upon, the Palmer Works; so completely, in fact, is the town identified with the works that it might more appropriately be called "Palmer's Town." Within the last fifty years a small colliery village has expanded into an important industrial town, with a busy and thriving population, which, in spite of occasional periods of depression, shows abundant signs of accumulated wealth and prosperity. It is in the Jarrow shipyard, famous for its pioneering in the manufacture of iron and steel, the building of every class of vessel, and the turning out of engines and boilers which have always been abreast of the times, where Mr. Malcolm Dillon and two advisers—Mr. J. L. Twaddell (a high authority on shipbuilding subjects) and Mr. J. W. Reed (well known throughout the North as a specialist in engineering and the patentee of the "Reed" water-tube boiler—are developing an epoch-making idea in marine engines. As it is of the internal combustion type, and worked by oil, the discoveries of these authorities will have a special interest for oil men. The Palmer Company, working in conjunction with the Griffin Engineering Company of Bath, is conducting a series of experiments which

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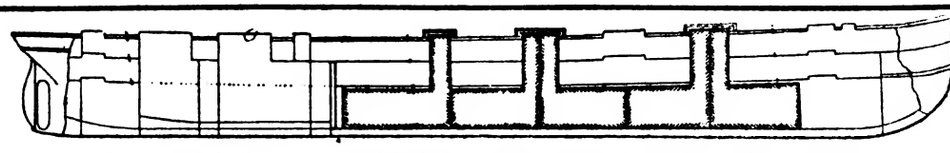
for the Red Star Steamship Company, of Antwerp.* So far as the actual launch was concerned it was a record for the world. There were oil-carrying vessels on the Caspian, but no tank steamers, and there were small wooden oil-carriers on the oily streams of Pennsylvania, but there was no ocean-going bulk oil vessel flying the American flag. The Jarrow-built *Vaderland* was undoubtedly the pioneer tank steamer launched in this country, and the element of mystery to which I have referred only comes in when the admission is made that it cannot be shown that oil was ever pumped into her tanks.

I have been told by men who worked on her that she had a complete inner skin 26 in. inside the outer skin at the centre line, diminishing to 20 in. at the bilge, and the beams forming the crown of the tank were plated above and below. The double skin idea was adopted in the case of several steamers launched a few years later, but it was found to be a source of danger, as it formed inaccessible spaces for the accumulation of explosive vapours.



The *Vaderland*. The first vessel built to carry oil in bulk. The section shows the tank arrangements of this vessel, the *Nederland* and *Switzerland*.

The tanks were fitted in her hold, but, as I have stated, it is not known that they were used for the transport of oil, the owners fearing that if it became known that the vessel carried petroleum in bulk her passenger bookings would be injured.

The secret of her first cargo was well kept. One unofficial and unpublished account (for nothing definite in regard to this steamer and her first voyage has been published) stated that she actually carried a cargo of oil, with the result that her third class passengers, whose berths were on the 'tween decks, protested and certain insurmountable difficulties arose at the port of discharge; but few will conceive it possible that she could discharge a cargo of oil without leaving a trace of the novel and important business on the records of some port or the books of one of our pioneer oil companies.

She was followed by the *Nederland* and the *Switzerland* in 1873 and 1874 respectively; but here, again, exactly what these steamers did in the oil trade—if, indeed, they did anything at all—it is impossible to find out, and it is not believed that they were really the vessels which solved the problem of oil transport in tanks.

Of these steamers it was said that "they were built with a good tumble home that sailors will appreciate," and also "that the arrangement of the tanks is good, and, being built on the cellular system, the advantages of water ballast are obtained with very much less risk of danger from leakage of oil."

The drawings of these steamers were destroyed during a fire which took place at the shipyard offices of the builders.

In September, 1879, when some forty European ports were receiving refined oil from America, the Norwegians started a new era in the marine transport of oil by sending the *Stat* to Philadelphia to load a cargo of crude petroleum in bulk. She was equipped with huge oil tanks. On October 18th she left Philadelphia for Rouen with the first cargo of petroleum ever loaded in a tank steamer bound east.

Five days after the *Stat* arrived, the Norwegian oil sailer *Lindernoer* reached Philadelphia, and was only one day ahead of the Norwegian brig *Jan Mayn*. These vessels were fitted up in the same manner as the *Stat*, and, like her, loaded crude petroleum for Rouen. The *Jan Mayn* cleared on October 22nd and the *Lindernoer* on October 30th.

The steamer and the two sailing vessels made good passages and discharged their cargoes into large

may revolutionise marine engineering and give oil one more advantage over coal in the propulsion of all kinds of small craft. It is interesting to recall the fact that the "Diesel" oil engine has superseded the one of the reciprocating type in several tank steamers on Russian waters.

* A Red Star liner, the *Kensington*, twin screws and steaming fourteen knots, was the first Transatlantic passenger vessel to cross the Atlantic with oil for fuel. She did this near the end of 1903, thirty-three years after the *Constantine* had pioneered liquid fuel burning on the Caspian, twenty-nine years after the Russian fleet on the Caspian started to use liquid fuel from the wells at Baku, and just eleven years after the tank steamer *Baku Standard* made her record as the first vessel to use oil on the Atlantic. The Red Star Company has another *Vaderland*, one of the largest liners running between Antwerp and New York.

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storage tanks at Rouen. Their arrival was an event of great interest in the ancient French port. The vessels ran without competition in the Philadelphia oil trade until 1880, when some French merchants fitted up the tank ship *Fanny*, and sent her to Philadelphia, where she arrived on August 30th, 1880, and loaded a full cargo of crude oil for Havre. She sailed on September 29th, but was never heard of, and it was thought that she blew up at sea.

When Baku oil, nearly a quarter of a century ago, started to compete with the American product, the tank steamer *Petrolea* and another ran regularly between Libau and the Baltic port of Lubeck in Germany. From Baltic ports 10,000,000 to 15,000,000 gallons of Baku oil found its way into Germany and other countries, "underselling and ousting the American article."

Charles Marvin, who first loyally championed Baku oil in its struggles against the European encroachments of American competitors, and who, with his remarkable gift of prophecy, declared that one might as well fear an earthquake swallowing up London as exhausting Baku of its oil, writing on the commercial aspect of the gigantic distributing problems of his day, said :—

"The theory that Baku petroleum will not profitably compete with American illuminating oil in the markets of the United Kingdom is completely upset by this triumph of the Caspian article in the Baltic, for if Baku oil can be carried by steamers on the Volga, and by railway across the whole Continent of Europe, and yet undersell the American article in German Baltic ports, how much more inexpensive the conveyance of Baku oil only 500 odd miles by rail to the Black Sea, and thence by cheap oversea bulk transport to this country!"

Almost before the era of a rational development of the Caucasian oil fields there were a few enterprising oil kings at Baku and Batoum with ideas of conquest in Eastern countries receiving oil from America by way of the Cape. The Russians, experienced in oil transport work on the Caspian, had ambitious ideas in connection with the Suez Canal. Twenty-five years ago, when these men were pouring petroleum through the Baltic into Germany and were looking forward to the materialisation of the gigantic Baku-Batoum railway idea for the transport of Caucasian oil, a London paper, *Good Words*, told its readers "that the petroleum in Caucasia was sufficient to supply the world for a prolonged period." Then it said :—

"It will certainly be a marvel, but one which may be before long realised, to see a petroleum fleet, laden at Batoum with Caucasian oil, pass through the Suez Canal without the aid of coal."

And again :—

"This would be an immense gain to the stokers, who have a bad time in the Red Sea, one of the hottest parts of the world, for petroleum ships require no stoking."

On January 14th, 1885, the following cable was received in New York :—

"The Black Sea Steam Navigation Company (Nobel) has given orders for the building of a fleet of steamers in Sweden and England. Each steamer is to be fitted with petroleum tanks, and will have a capacity for 1,500 tons per trip. The design is to compete with the vessels in the American petroleum trade. M. Trodel, a Russian contractor, is preparing to send oil in bulk to London from Libau, on the Baltic, next spring."

"No competition of this magnitude has ever before been met with in any foreign market," was the comment of an American oil authority. "For several years news respecting the large yield of oil at Baku has occasionally appeared in the Press, and, from time to time, warnings have been heard that, sooner or later, the supremacy of American oil in the European markets would cease, and that this region, in the near future, would become a formidable rival for the supply of petroleum. American producers and refiners have hitherto affected to ignore the claims and statements, but a careful perusal of the facts must arouse both the producer and the shipper to prepare for the most formidable competition they have yet encountered."

These were the years when Russia and America came into conflict for the first time. About that time (1885) the export of the American oil in a single year was accomplished by over 1,000 vessels, mostly foreign sailing ships, carrying from 2,500 to 14,000 barrels per voyage.

Thus wrote Marvin in that "Wake-up-England" manner that one comes across so frequently in his works :—

"We pride ourselves on being the 'carriers of the world,' yet we have allowed the over-sea traffic in oil to be taken possession of by foreigners, and are making no strenuous endeavours to prevent the new system from passing completely into their hands. Otherwise the *Sviet* and the *Gluckauf* would have been English-owned and English-named tank steamers. The trade is not one to despise. If one hundred

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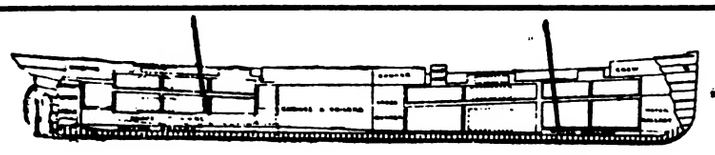
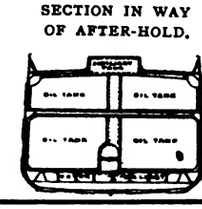
steamers are required on the Caspian for the market of Russia, is there much fear of English tank steamers having to lie idle for freights in the Black Sea, if prepared to carry to the United Kingdom and elsewhere by the bulk system the marvellously cheap oil of Baku. Storage arrangements for accommodating millions of gallons of oil are being, or have been already, erected at Odessa, Smyrna, Fiume, Trieste, Genoa, Marseilles, Antwerp, Bremen, and Libau, and everywhere in Europe the petroleum trade is beginning to adapt itself to the new condition. There is not a country in Europe to which Baku oil is not shipped to-day."

Mr. Edward Stack, of the Indian Civil Service, was at Baku in 1881. "The out-turn of the naphtha springs," he wrote, "was about 160,000 tons last year, and is increasing yearly. Difficulties of transport hinder this trade to a certain extent, but these will be largely surmounted if the American plan be adopted. . . . At present the naphtha is transported chiefly by water. A hundred and fifty vessels lie in the harbour, mostly schooners of 90 to 200 tons; but some three-masted steamers belong to the port, the largest being of 1000 tons burden. Nobody can spend half an hour in Baku without seeing that it is a very rich and flourishing place. I envied it for India."

The *Fergusons*, built as an ordinary cargo vessel by Messrs. Bertram, Haswell & Co., of Sunderland, was converted into a tank steamer by Messrs. Craggs & Sons, of Middlesbrough, in 1885. Her records included the first trip from this country to Batoum for oil, and also, it is said, the first run across the Atlantic for a cargo of American petroleum.

Mr. Henri Rieth, who represented Nobel Bros. at Antwerp, recognising the immense commercial advantages of the bulk oil transport system in vogue on the Caspian Sea, pointed out to Mr. J. M Lennard, shipowner, of Middlesbrough, and head of Messrs. Lennard & Sons, who to-day have their London office in Great St. Helens, the importance of running a tank steamer in the Russian oil trade. The Transcaucasian railway and pipe line had made it possible to deliver Baku oil at Batoum, and Mr. Lennard was not slow to recognise the value of a business connection with Nobel Bros., who had done so much for the petroleum-producing industry at Baku and the distribution of the oil in many of the greatest centres of population on the Continent. Mr. Rieth and Mr. Lennard consulted Messrs. Craggs & Sons. This combination of petroleum, shipping and shipbuilding experience, convinced of the commercial advantages of the project, did not take long to decide that there were no serious shipbuilding or engineering difficulties standing in the way of the adoption of the ideas originally submitted by Mr. Rieth. At that time a great deal of prejudice was being displayed against the bulk oil trade, but, as the head of the Middlesbrough shipbuilding concern pointed out, "if oil could be held in cases and barrels a ship could be made to hold it in bulk." They recognised a good margin for economising; against the existing system it was urged that there was always a leakage from the cases and barrels, extra tonnage was required, and questions of cost and repair were too serious to be overlooked.





The *Fergusons*. Built in 1880, and converted into a tank steamer in 1885.

The conversion of a tank steamer was admittedly an experiment, and the builders had nothing to guide them in the shape of practical experience or even

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information from other shipbuilders. There being no time to build a new vessel, the *Fergusons* was taken in hand by Messrs. Craggs & Sons, who undertook to convert her into a tank steamer capable of carrying from 1,500 to 2,000 tons of oil. As her class at Lloyd's had to be preserved they were not allowed to interfere with the structure of the vessel.

The full size dimensions were obtained from the builders and a number of tanks were constructed to fit closely into the holds. The plans show a tier of tanks in couples above the beams, and a tier of larger tanks in couples below the beams, made to conform to the internal moulding of the vessel. The tanks were built in the shipyard berths, launched, and towed in rotation to the sheer legs on the arrival of the vessel.

The deck plate and beams were removed for a wide enough space in each hold to admit the largest tanks, and these were lowered and launched to their places on greased thin iron flats and securely wedged into their proper positions by wooden battens and blocks.

It was found that the fit was so tight that a rather large rivet head would cause a good deal of trouble in passing a beam. Some beams were consequently removed and chains with powerful tightening screws temporarily used in their place to enable the tall tanks to pass fore and aft, where the sheer of the vessel gave greater height.

The lower tier of tanks, up to about middle height, were constructed of $\frac{3}{8}$ in. plate iron, above that of $\frac{5}{16}$ in. plate; angle iron stiffeners 3 by 3 by $\frac{3}{8}$ in. were spaced 2 ft. apart over all the plating, and the corner bars or frames were the same size. The upper tier of tanks were built of $\frac{1}{4}$ in plate throughout, stiffened in a similar manner to the lower ones. All the oil-tight joints were closed with $\frac{5}{8}$ in. rivets spaced $2\frac{3}{8}$ in. apart centres.

The rivetting was very carefully overlooked, and as a precaution hardened up cold. The holes were carefully spaced, angle iron stays, horizontal and vertical, were attached by gussets to every stiffener, and the verticals were secured by diamond plates to their respective horizontals. Before launching, each tank was tested to a head of 11 ft. of water.

Powerful pumps were fitted to each hold. A main pipe had branches with valves to each tank. Expansion was allowed for by connecting by a smaller set of pipes each of a group of tanks to a regulator, in which a little oil was always kept under the control of the pumps.

When the *Fergusons* left the Tees as a "converted" tank steamer she proceeded to Batoum, where she loaded her first cargo of oil for delivery at Mr Rieth's tanks on the Scheldt.

A shipbuilding authority of that day expressed the opinion that her arrangement of tanks was not likely to be copied, and the first time the vessel got into heavy weather it was found that there was a considerable movement of the oil and that the joints between the tanks could not be kept tight.

She ran in the oil trade for some three years (1889), when she was destroyed by an explosion at Rouen. She was literally torn to bits by two separate explosions; one report stated, by the accidental production of an electric spark, and another, by a workman smoking in one of the tanks. The first explosion shattered a number of the tanks, while the second completed the destruction of the hold, and bursting the hull, liberated a quantity of burning petroleum.

The tanks at Antwerp into which the *Fergusons* discharged her first cargo of Russian oil subsequently became the property of the Standard Oil Company.

Before the advent of vessels to carry oil in bulk a large trade had grown up in the carriage of petroleum—first in barrels, and afterwards in tin cases, rectangular in shape. The cases were found to facilitate the marketing of the oil, as two cases could be slung on the back of a strong draught animal or two tins on a weaker one. This obviated the necessity of breaking into packages such as barrels of 40—50 gallons. The cases were considered superior to the barrels; they fitted close to one another and a greater quantity of oil could be carried in a given space. Even with the most perfect workmanship leakage on a large scale took place, and this meant, not only a considerable loss of oil, but a serious danger to the ship, for the oil gave off explosive gases. To avoid this risk and save expense the suggestion was made that the vessels themselves should have tanks into and out of which the oil might be pumped. The builders started with the idea that there must be separate containing tanks; but after two or three vessels had been built upon the tank system proper the principle of separate tanks was abandoned. The tank system in its primitive stages proved to be even more dangerous than carriage by means of tin cases. With every possible care there was leakage, and the escaping oil evaporated and filled the spaces beneath the tanks and the sides of the ship with explosive gases. It was found impossible to properly clear these spaces or effect repairs. No naked lights could be used, and,

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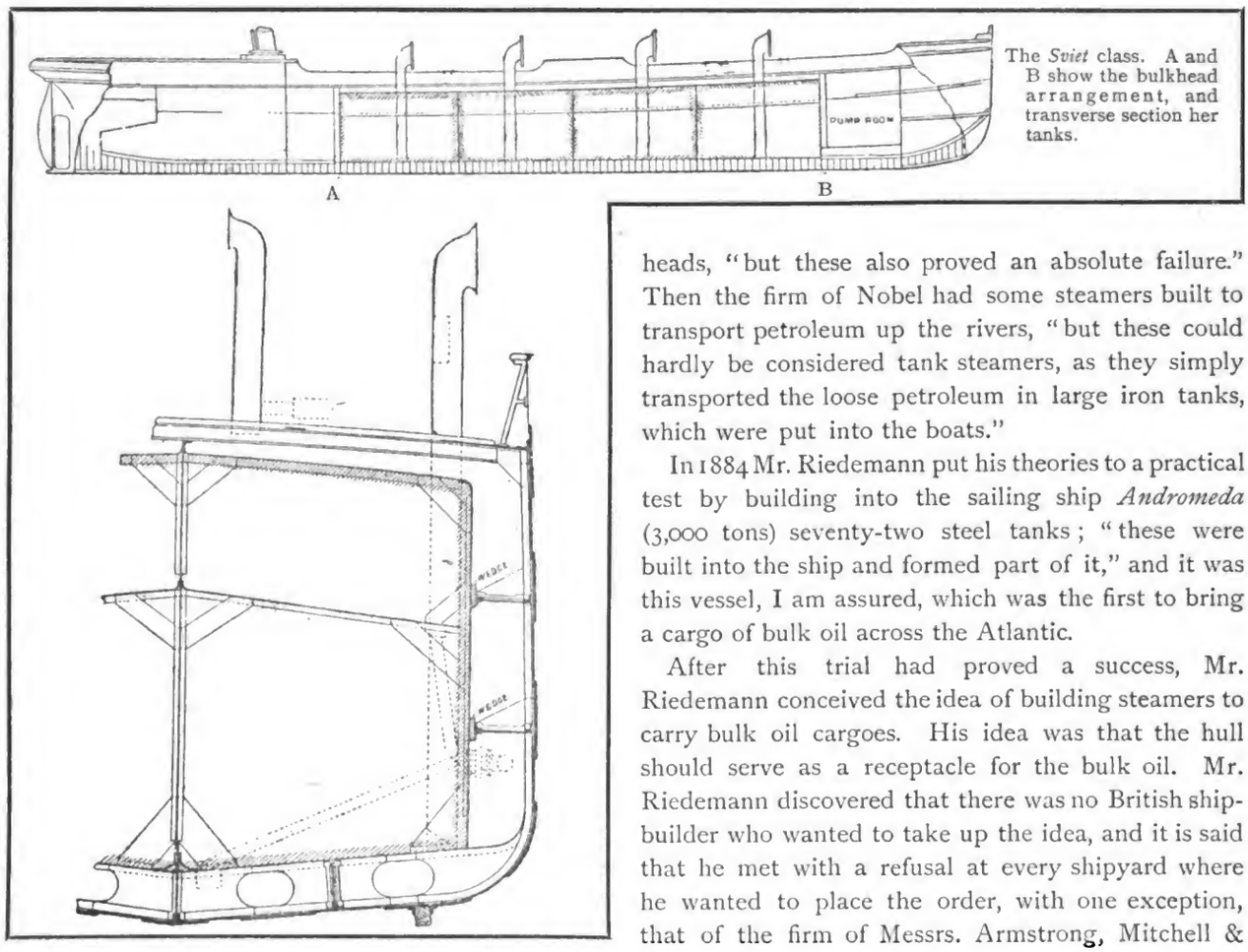
of course, the insertion of hot rivets was out of the question. The separate tank system was not only more risky than carriage by means of cases and barrels, but it proved to be far more expensive.

As I have said, the next development was to utilise the vessel herself as the tank containing oil, partitioning off a portion at both ends to secure buoyancy, to give room for engines and quarters for the crew, and to hold the pumping machinery. The 'tween decks were used for coal bunkers and storage.



The *Sviet* class. A and B show the bulkhead arrangement, and transverse section her tanks.

With this system there was practically no loss of oil, and most of the steamers are now constructed in this way.

Well before British oil men had got deep into the business, German firms had started to display enterprise in the importation of oil from Russia and America. One of the first American merchants to take an interest in oil-carrying shipping was Mr. Heinrich Riedemann, of Bremen,* on whose behalf it has been claimed that he was the first advocate of the practical adaptation of the theory of petroleum in bulk transport.

The facts of the case of Mr. Riedemann are, that the steamers *Vaderland*, *Nederland* and *Switzerland* were "passenger boats, with water ballast tanks, which some thought might be used for the transport of oil, but, the idea proving impracticable, they were never used for the transportation of oil." Another trial was made with wooden sailing ships, which had their oil-carrying compartments formed by wooden bulk-heads, "but these also proved an absolute failure." Then the firm of Nobel had some steamers built to transport petroleum up the rivers, "but these could hardly be considered tank steamers, as they simply transported the loose petroleum in large iron tanks, which were put into the boats."

In 1884 Mr. Riedemann put his theories to a practical test by building into the sailing ship *Andromeda* (3,000 tons) seventy-two steel tanks; "these were built into the ship and formed part of it," and it was this vessel, I am assured, which was the first to bring a cargo of bulk oil across the Atlantic.

After this trial had proved a success, Mr. Riedemann conceived the idea of building steamers to carry bulk oil cargoes. His idea was that the hull should serve as a receptacle for the bulk oil. Mr. Riedemann discovered that there was no British shipbuilder who wanted to take up the idea, and it is said that he met with a refusal at every shipyard where he wanted to place the order, with one exception, that of the firm of Messrs. Armstrong, Mitchell & Co. This firm, especially Mr. Swan and old Mr. Mitchell, finally fell in with the idea of Mr. Riedemann, so that in 1885 the first tank steamer, the *Gluckauf*, was constructed.

This steamer discharged her first cargo in July, 1886, at Geestemunde, and, as she proved "impervious to leakage," it was said "that it did not differ in any way from carefully barrelled oil."

She was built from the designs of Col. Henry F. Swan, was a vessel of 2,307 tons (gross register), 300 ft. long, three-masted like an ordinary cargo steamer, and steamed about 11 knots. She was

* Connected with the Deutsch Amerikanische Petroleum Gesellschaft, Hamburg.

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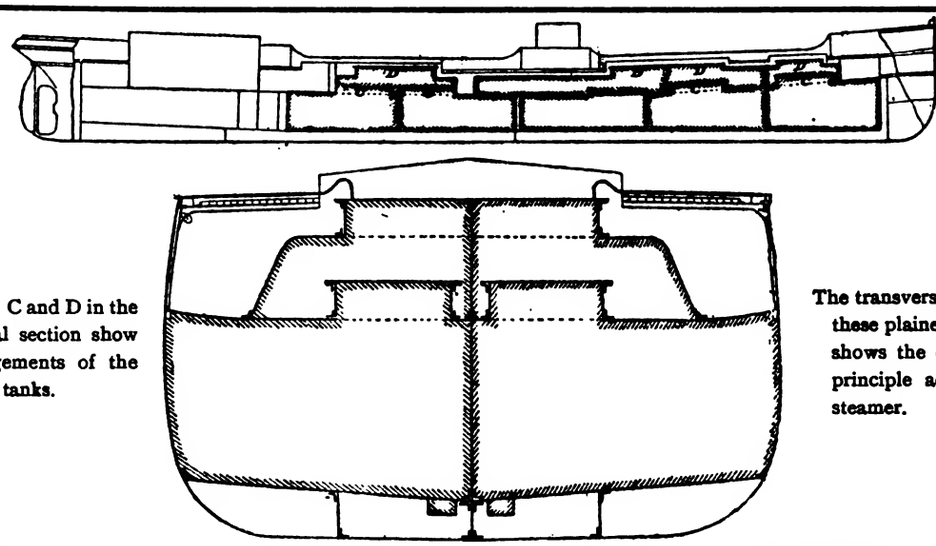
practically boiler-riveted throughout. The hold was longitudinally divided by a middle line bulkhead, and she had a large number of compartments extending to the hull itself. Some Caspian tank steamers, built six or seven years before, had their oil compartments extending right to the outer skin, but Mr. Riedemann considers the *Gluckauf* was the first ocean-going steamer in which the system was adopted. In this respect she was a success. She had special arrangements for the expansion and contraction of the liquid cargo, the details of which were carried out on a system patented by the builders. The water ballast tank was conical. Col. Swan's idea was to effectively collect all oil that might escape from the cargo tanks, and oil flowing into the water ballast section floated up the midships trunkway, where it was pumped into her length was 286 ft.; depth, 18 ft. and speed 11 knots. She had a single tank in which she carried all her cargo.

The arrival of this steamer with more than half a million gallons of Russian oil in bulk, instead of barrels, after a safe and easy passage across the Bay of Biscay, reduced the croakers to silence.

During the three or four years preceding 1885, when these pioneer tank steamers started to run, many sailing vessels were converted into oil carriers. For some time there was a difference of opinion as to what were the proper principles applicable to the construction of these vessels, and especially as to the important question whether tanks separate from the skin of the ship should be provided, or whether the



The *Bakuin*. C and D in the longitudinal section show the arrangements of the expansion tanks.

The transverse section makes these plainer still, and also shows the cellular bottom principle adopted in this steamer.

the main tank. It was pointed out at the time that in the case of illuminating oil it could not very well be pumped back without risk of damaging the cargo. The pumping appliances could discharge her cargo in twelve hours. The engines were of the triple expansion description, and the vessel was electrically lighted.

After her, Mr. Riedemann ordered the *Vorwarts*, *Gut Heil*, *Willkommen*, *Energie*, and *Minister Mayback*, and when these steamers started running others took up the idea and went on building from 1888 onwards.

In the same year (1885) a new factor in the petroleum-carrying trade made its appearance in the shape of the tank steamer *Sviet*, built at Gothenburg for the Russian Steam Navigation and Trading Company, of Odessa. She was 1,474 tons net register; skin should form part of the sides of the oil tanks. The sailing ships *Andromeda* (alluded to in my reference to Mr. Riedemann) and *Crusader* were fitted with a large number of independent tanks, and necessarily so, since the vessels themselves were not built for the oil trade, but it is worthy of note that the same arrangement was adopted from choice in the construction of the iron tank steamer *Sviet* and to some extent in the *Bakuin*, which was built very shortly afterwards.

When British oil men once realised the immense practical and financial advantages of carrying oil in bulk, the trade started to rapidly increase, and, while in 1886 there were only about twelve bulk oil-carrying vessels, there were in 1891 between seventy and eighty running from America and Baku to European oil importing ports.

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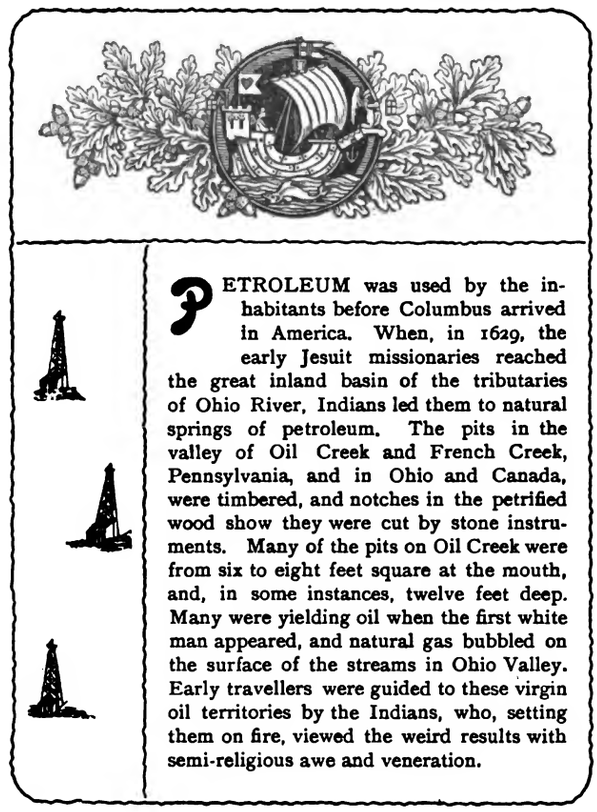
The oil-carriers of the eighties were in tonnage only one-third the size of some of those launched during the past few years. Nearly all the essential knowledge required for the safe, quick and profitable working of the trade was gathered during the first three years, 1886 to 1889, by those in charge of tankers. Since 1890 there has been comparatively little alteration in the form of the vessels, with the exception of the placing of the engines amidships.



PETROLEUM was used by the inhabitants before Columbus arrived in America. When, in 1629, the early Jesuit missionaries reached the great inland basin of the tributaries of Ohio River, Indians led them to natural springs of petroleum. The pits in the valley of Oil Creek and French Creek, Pennsylvania, and in Ohio and Canada, were timbered, and notches in the petrified wood show they were cut by stone instruments. Many of the pits on Oil Creek were from six to eight feet square at the mouth, and, in some instances, twelve feet deep. Many were yielding oil when the first white man appeared, and natural gas bubbled on the surface of the streams in Ohio Valley. Early travellers were guided to these virgin oil territories by the Indians, who, setting them on fire, viewed the weird results with semi-religious awe and veneration.

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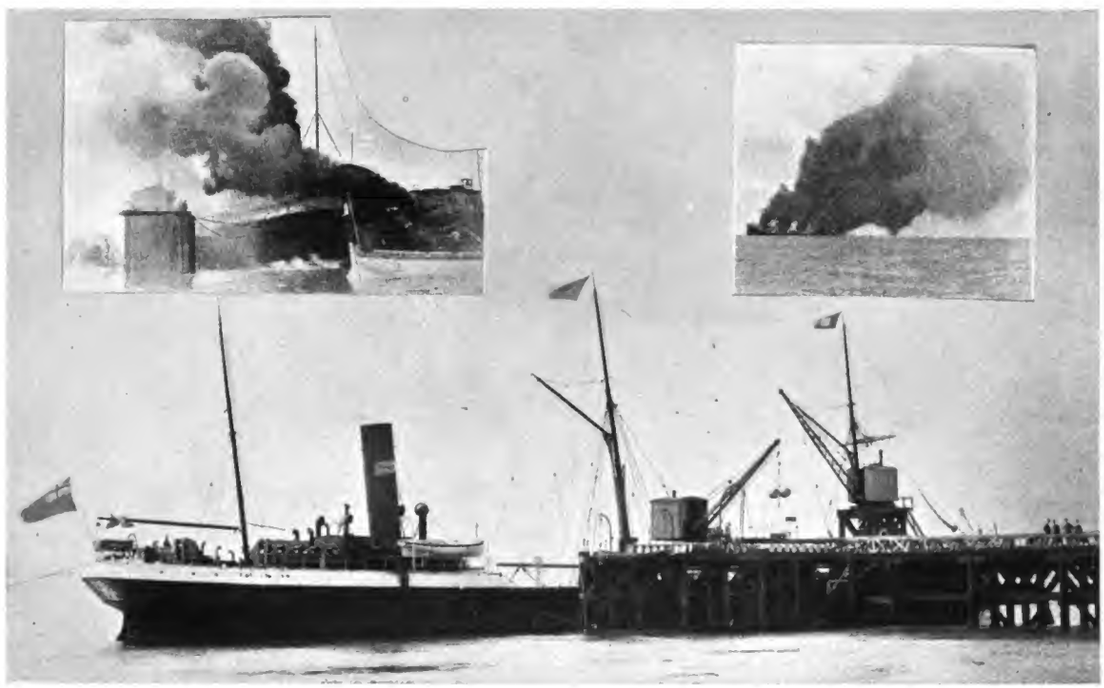
THE BAKUIN.



DISCHARGING BULK PETROLEUM AT THE THAMES HAVEN WHARF ON ONE OF HER FIRST VOYAGES TO THE THAMES.

INSET, VIEWS OF THE DESTRUCTION OF THE STEAMER BY FIRE IN CALLAO BAY, PERU.

[*To face p. 14.*

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CHAPTER II.

Ships and Freights of 1886–88, and the Inauguration of the Distributing System in England.

THE *Bakuin* was an epoch-making steamer. Built at Hartlepool by Messrs. W. Gray & Co. for Mr. Alfred Suart, in 1886, she was the first British-owned tank steamer turned out of a British shipyard. On her first voyage, when she was commanded by Captain Kortright (afterwards killed by an explosion on the *Petriana*), she discharged a cargo of lubricating oil at Hamburg.

This vessel was considered to be an advance on all oil-carrying steamers of the converted type, and one expert * considered she carried her cargoes very well. She had a cellular bottom, the crown of which formed the bottom of the oil tanks. Above the cellular bottom, to the height of the 'tween decks, the oil extended to the side. In the 'tween decks there were a number of additional oil compartments. They did not extend either to the side of the vessel or to the deck above, and it was claimed for this plan that, while the oil in the main hole could never reach a high temperature, owing to the immersion of the vessel, the tanks in the 'tween decks, by being so formed, were kept at a much lower temperature in hot climates than if they extended to the sides. Her designers claimed that in the event of injury to the hull by collision or otherwise, the tanks would, under ordinary circumstances, escape injury.

Her engines were aft. A double bulkhead was fitted before the boiler space, and another at the fore end of the foremost oil compartment. The hold was further separated into two distinct divisions by an additional pair of adjacent transverse bulkheads. The object of this arrangement was to allow oils of different qualities to be carried on the same voyage without danger of mixing. Arrangements were made by which, with oil in the hold, other descriptions of cargo could be carried in the 'tween decks. With this object, expansion tanks on the middle deck communicated with the cisterns in the hold, and were capable of being closed, air pipes being fitted through the cover to the upper deck. Additional expansion tanks built on the roof of the 'tween deck cisterns, within the area of the upper deck hatchways, were for use when both the tanks in the hold and 'tween decks were filled.

All valves regulating the filling and emptying of the tanks were placed in the engine house, and by means of an arrangement of floats connected with wires, the level of the oil in each tank could be ascertained at the same place. She was electrically lighted, and had a pumping equipment to discharge a full cargo of 1,950 tons in twelve hours.† Respecting her it was said: "Great care appears to have been taken in the construction of the *Bakuin* to avoid all possible sources of risk from fire. The cabins are heated by steam instead of by coal fires, and the cooking was done by steam." She was destroyed by fire when in the floating dock at Callao Bay, Peru, in September, 1902.

Lloyd's agents, when they reported her "very badly damaged by mixed causes," recommended that the wreck should be sold by auction "for the benefit of all concerned," adding, laconically, "the sale will probably realise £50."

A cargo of bulk petroleum was brought to the Thames by Messrs. Lane & Macandrew in 1886. The steamer was the *Petrolea* (afterwards the *Ludwig Nobel*), with a Russian in command. It consisted of 1,000 tons, and was shipped at Libau. On her arrival the *Petrolea* was moored in the Regent's Canal Dock, and permission was obtained from the authorities to sink a pipe line beneath the streets from the dock side to the Atlantic Wharf, Bow, where it was pumped

* Mr. Little.

† The newest vessels have isolated pump rooms in charge of a skilled mechanic.

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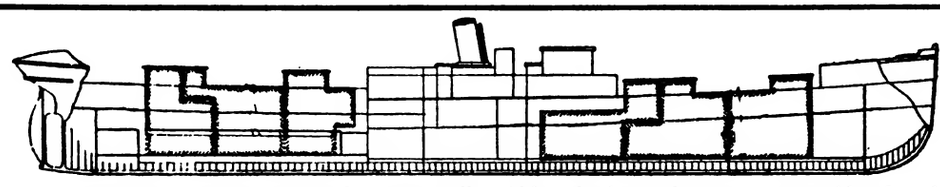
into some lead-lined tanks. That was the start of the bulk oil trade in this country.

The *Petrolea* arrived at the time when supplies were short ; a number of oil-carrying sailers, delayed in the Channel by strong easterly winds, could not make the Thames, and the landing of 1,000 tons of oil in bulk naturally created some excitement on the market. The oil sold at a good profit.

For many years before the arrival of this cargo hundreds of sailing craft were employed in the barrel oil trade of the Atlantic. They were not of the fast clipper type, and their arrival, depending on the unbought but uncertain wind, was not regular enough to maintain reliable supplies.

One of the first bulk oil cargoes—I think the second—was brought to this country by the converted tanker *Petriana.* Commanded by Captain Davies, she made the run from Batoum to Liverpool in eighteen days, and encountered her first severe gale in the English Channel, when her behaviour proved to those interested that a converted tank steamer made a good sea boat. She started to discharge 2,000 tons at Liverpool on December 11th, 1886.



The *Chigwell*, one of the first steamers converted to carry oil. Although the tanks were not considered to be a success at the start she has proved a good vessel, and even to-day carries her cargoes exceedingly well.

A few weeks before this cargo reached England, the *Marquis Sicluna* had arrived at Fiume, Austria, with a cargo of kerosene.

Messrs. Lane & Macandrew made another innovation in the same year. They sold the first cargo of Russian case oil for shipment to the Far East. Mr. Lane was in Batoum when he secured the offer of a full cargo, and, cabling Mr. Macandrew, an arrangement was made with the owners of the Newcastle steamer *Rimpha* to carry the oil from Batoum to Bombay for 37*s.* 6*d.* on the net register. This was the first steamer to carry case oil through the Suez Canal. To show the amazing rapidity with which some of the first deals in the commerce of petroleum were put through, I may mention that this steamer had scarcely left for the Far East when the London firm received orders for 2,000,000 cases of oil, with the result that there was some brisk chartering of steamers to carry case oil to various ports of India.*

Beg Mahomed, an Indian merchant, was early in the Batoum-Bombay oil trade, and his success quickly brought into the market such well-known firms as Ralli Bros., Wallace Bros., James Mackintosh and a number of natives. Mantascheff & Co. led the way amongst purely Russian concerns for shipments of Russian oil to India ; that was several years before the Standard and Shell Companies appeared in these extensive markets. Ninety-five per cent. of the oil cargoes were carried in British bottoms.

The *Petriana* and *Chigwell* were converted for Messrs. Alfred Suart & Co. in 1886, the *Chigwell* having been built by Messrs. Bertram & Haswell, of Sunderland, at the end of 1883. Her dimensions were 258 ft. 8 in. by 36 ft. 2 in. by 18 ft. 7 in. Her tonnage was 1,824 gross, and 1,192 net, while her engines were 178 h.-p. She was intended for the general cargo trade, and her first voyage was from the Tyne to Trieste with a cargo of gas coal. After running successfully for three years she was converted into a tank steamer to carry oil in bulk. Her conversion was new work, even for Tyne shipbuilders, and the order was given to Messrs. Hawthorn, Leslie & Co., whose shipbuilding yard is at Hebburn, half-way between Newcastle and the mouth of the Tyne. Mr. Leslie was a Scotchman, and a self-made man, famous in his day for the way in which he built up his business at a time when the Tyne shipbuilding industry was in its infancy. When he started, Lord Armstrong was beginning his career as a shipbuilder higher up the river, while, just two miles nearer the mouth of the Tyne, Sir Charles Mark Palmer, referred to in the previous chapter, was bringing the town of Jarrow into existence, and developing what has

* Owing to the strikes and political troubles at Batoum the Russian case oil trade has been practically wiped out, and this firm, instead of shipping 2,000,000 to 3,000,000 cases a year, has ceased to seriously take an interest in it.

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since become one of the largest iron and steel-making works and shipbuilding establishments in the world.

Mr. Leslie took a great interest in the work of converting the *Chigwell* into a tanker. Under the new arrangement the *Chigwell* had seven tanks, of which four were forward and three aft. The largest held 420 and the smallest 160 tons. She was provided with expansion tanks, and had longitudinal bulkheads fore and aft. She was fitted with electric light, and all the necessary pumps to empty her tanks at the rate of 50,000 gallons per hour.

The *Chigwell* arrived at Hebburn in April, 1886, and, having been altered, she left on her first voyage to Batoum on August 25th, reaching the Black Sea port in September. She was chartered by the Mineralöl Raffinerie Actien Gesellschaft, of Budapest (Messrs. Lane & Macandrew, Great St. Helens, being the brokers). The charter party set forth that she was to trade for three or six years principally between Fiume and Batoum. The shippers at Batoum were the Société Commerciale et Industrielle de Naphthe Caspienne et de la Mer Noire. At the Black Sea port she was an object of much curiosity. At that time the loading arrangements at Batoum were crude, and the *Chigwell*, during a gale of wind, dragged the loading wharf away and did damage to the extent of £100. The crew had to run out deck lighters between the wharf and the ship, and the cargo was loaded over the stern. She left Batoum on September 21st, with 1,964 tons of crude oil in bulk for Fiume, and when this was discharged it was found to be in perfect condition. Fiume, even at that time, had admirable accommodation for discharging cargo, and the *Chigwell* had no difficulties with the port authorities. In a single year she made fifteen voyages between Fiume and Batoum. The quickest was made in twenty-eight days.

In 1887 she crossed to Philadelphia, where she made another record, being the first tank steamer to load oil at that port. In 1889 she discharged at Rouen, after having made a second trip to America. In her day she was looked upon as an exceedingly strong vessel, and carried her cargoes very well indeed.

Messrs. Suart & Co. built most of the early British oil-carrying steamers, and all of them, with one or two exceptions, are engaged in the trade to-day, though they fly the flags of other companies. Before 1892 they managed the following steamers:—

	Year.	Tons.
Baku Standard . . .	1892	5,000
Broadmayne . . .	1888	4,200
Luceline	1893	4,000
L'Oriflamme . . .	1892	3,900
Prudentia	1889	3,900
Wildflower	1889	3,900
Tancarville	1889	3,200
Robert Dickinson (converted)	1887	2,650
Vindobala (converted) .	1889	2,350
Bakuin (built) . . .	1886	2,350
Chigwell (converted) . .	1886	2,150
Petriana (converted) . .	1886	2,125
Titian (converted) . .	1887	1,700
Petrolea	1890	3,900
Prudence	1890	3,900
Allegheny	1891	4,000

One of these steamers cleared herself after making ten voyages; she got as much as 35*s.* 6*d.* per ton, against 22*s.*, this year's rate, and 10*s.* or 12*s.*, the figure for last year.

To show the state of the bulk oil-carrying shipping trade, I give the following particulars of some early charters: November, 1886, *Bakuin*, Batoum to U. K., 25*s.* for five years; February, 1886, *Petriana*, U. K. to Continent, 20*s.* for ten years, option Adriatic, 16*s.*, September, 1886, *Chigwell*, Black Sea to Adriatic, 13*s* 6*d.* for three years; May, 1887, *Charles Howard*; Batoum to Mediterranean, 14*s.* for two years; September, 1886, *Titian*, Batoum to Mediterranean or U. K., Mediterranean, 14*s.*, Continent, 21*s.* for two years and option for another two years; August, 1887 to March, 1888, *Marquis Sicluna*, various voyages Batoum to London and Liverpool, 21*s.* to 22*s.* 6*d.*; July, 1888, *Robert Dickinson*, Batoum to Adriatic, 13*s.* 6*d.* for three years; and April, 1889, *Rocklight*, United States to U. K., 27*s.* 6*d.* (2*s.* 6*d.* higher than the rate for 1907, but 12*s.* 6*d.* higher than that of two years ago). When the *Elbruz*, *Kasbek* and *Darial* were built in 1888 (on a contract of 20*s.* a ton), they were chartered at 20*s.*, although the statement is made that one was chartered for 45*s.* Chartering facts of recent years are given in the appendix.

Among the first vessels built by Messrs. R. Thompson & Sons, of Sunderland, for the bulk oil trade was the *Wildflower*, lost with all hands (Captain Stanwell in command) after leaving Philadelphia. The *Hafis*, built by Messrs. Hawthorn, Leslie & Co., Hebburn, in 1886, was a successful tanker of that day

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She was built originally for the American Cotton Oil Company, and her design did not militate against her employment as a petroleum tank steamer.

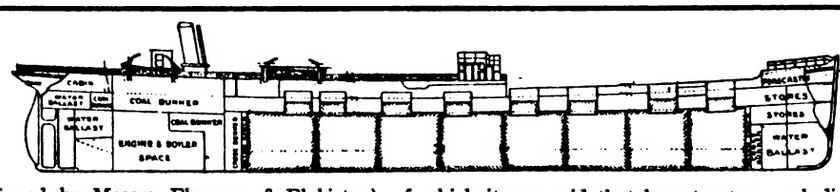
Later (1887) the *Era* (re-christened the *Apscheron* when she was transferred to the Société Anonyme, Antwerp) was built by Palmer's Company, from designs prepared by Sir E. J. Read, one of a group of tank steamer authorities which included Mr. W. H. White, R.N., chief constructor to the Admiralty; Professor Jenkins, M.A., of Glasgow University; Mr. B. Martell, chief surveyor of Lloyd's; Professor Tate, F.I.C., of Liverpool; Sir Boverton Redwood, F.I.C., F.C.S., D.Sc., F.R.S.E., and Sir Fortescue Flannery.

Like the *Oka* (now the *Broadmayne*), built by the same company about fifteen months afterwards, the *Era* was looked upon as a most perfect specimen of her type. The *Oka* was 334 ft. long; 40 ft. beam; and 16 ft. 9 in. deep. She carried about 3,000 tons of oil, and when she first started to run it was said of her that it was doubtful if she could be upset—something that could not be said of all the early tank steamers. The *Oka* was larger than the *Era*. Of the *Era*, *Oka* and *Charlois* (built by Messrs. Russell & Co., Greenock) it was said that "they fully solved the problem of carrying oil in bulk."

Absolute confidence was not felt in the tank steamer business at the start. Fifteen years ago there were some authorities who considered that the oil trade might prove a failure, and they thought it wise to build steamers which could be readily converted into ordinary cargo steamers. This was done at a time when the oil trade received a serious check through the war of tariffs and retaliatory measures adopted by the Russian and German Governments. These caused the import of Russian oil into Germany to cease entirely, and several oil vessels were thrown out of employment.

The arrangement was to cut down the trunks in order to form a hatch in the main deck. An arrangement of this kind was made in some vessels built by Sir Raylton Dixon & Co., for Mr. Lennard, and instead of the expansion trunks being fitted on each side of the middle line bulkhead they were placed at the sides of the vessel, allowing a clear space for the stowage of general cargo. This was considered a great improvement and specially adapted to meet the contingency.

Near the end of 1888 the Kerosene Company* had the small Dundee coaster *Valaria* converted into a tank steamer at the Wallsend Slipway. Bulkheads were so arranged that she had three tanks. In January, 1889, and on the same day that the *Darial* left the yard of Messrs. Armstrong, Whitworth & Co. the *Valaria* left the Tyne for Thames Haven, where she loaded her first cargo of oil for Portsmouth, Exeter and Gloucester. She was the first tank steamer to run in the British coastwise trade. She carried her own barrelling apparatus, and at each port coopers were employed to make barrels into which the oil was pumped for storage in corrugated iron sheds.



The *Charlois* (designed by Messrs. Flannery & Blakiston), of which it was said that her structure, sub-divided by bulkheads into compartments of moderate size, formed the necessary receptacle for carrying the oil. She was an innovation and an improvement on the system of building separate tanks into the ship.

She was employed in this trade for fifteen months, delivering oil at Portsmouth, Poole, Exeter, and Plymouth in the English Channel; Gloucester, Sharpness, Bristol, Swansea and Penarth in the Bristol Channel; Liverpool, Birkenhead, Dublin, Newry, and Galway. Cargoes for the Mersey and Irish ports were loaded at Barrow-in-Furness, which was one of the first oil ports in this country, just as it is to-day one of the most important.

When she ceased to fly the British flag she was placed under the control of the Paris house of the Kerosene Company and started to run between

* This company was formed in 1887 by Messrs. Lane & Macandrew and Mr. Wallace for the distribution of oil in this country. Out of it grew the Anglo-Caucasian Oil Company, afterwards the Consolidated, and now the British Petroleum Company (an amalgamation of the Consolidated and General). Other distributing concerns were formed, and of these the most important is the Homelight Oil Company (the important Gukassov-Mantascheff combination) for the distribution of Russian oil in this country.

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Havre and Rouen, while twelve months later she carried oil to Spanish ports.

At that time some of the tank steamers, including the *Darial*, *Elbruz* and *Kasbek*, used to discharge at Regent's Canal Dock. The ship's hose was attached to a pipe at the dock side and the oil was pumped through to the storage tanks on Bow Common.

Messrs. H. E. Moss & Co. (founded by the late Mr. H. E. Moss, uncle of the present head of the firm, Mr. E. A. Cohan) were prominently connected with the oil-carrying trade so far back as 1886, when the importation of bulk petroleum was in its infancy. This well-known shipping house was started in 1840, the London office being opened in 1862 and the Newcastle one in 1889.

Liverpool had then very poor and inadequate storage accommodation; this consisted of a receiving tank used in the barrelling off, which entailed heavy expenses and serious detention. In recent years the port has secured extensive and up-to-date tank installations.

One of the first cargoes of bulk petroleum discharged at Liverpool by a specially constructed tank steamer came out of the *Lux* (2,000 tons). That was in 1887. She was owned by the builders, Sir W. G. Armstrong, Mitchell & Co., and the charterers and receivers of the cargo were Messrs. R. Stewart & Co., Liverpool, the business being arranged by Messrs. H. E. Moss & Co., and the rate paid 42*s.* 6*d.* per ton.

This firm, seeing a bright future for the bulk petroleum business, induced Messrs. Stewart to build a steamer for their own account. This was the *Phosphor* (2,700 tons), and about the same time they contracted for a boat for themselves—the *Lumen* (3,200 tons)—which has proved most successful and is still running in perfect order.

This was followed by Messrs. Stewart building the *Beacon Light* (3,700 tons), and Messrs. Moss & Co. gave orders for the steamers *Lucerna* (4,200 tons), *Lucigen* (now the Anglo-American Oil Company's *Tonowanda*, 4,400 tons), and a still later *Lucigen*, which as recently as May, this year, also passed into the hands of the Anglo-American Oil Company, and is running under their flag as the *Cuyahoga*.

In 1889 Messrs. H. E. Moss & Co. became extensively connected with the oil trade; they chartered and built tankers, and from then to the present time they have acted as brokers in the building of dozens of steamers, both for home and foreign account. Among the number are the

	Tons.		Tons.
Phosphor ...	2,700	*Daghestan* ...	3,700
Lumen	3,200	*La Campine* ...	3,195
Beacon Light ...	3,700	*La Flandre* ...	3,600
Lucerna ...	4,200	*Rotterdam* ...	5,150
Lucigen (now *Tonawanda*)...	4,400	*American* ...	4,500
Astral	2,700	*Tiflis*	3,200
Aral	3,700	*Erivan*	2,750
Astrakhan ...	4,500	*Lucigen* (now *Cuyahoga* ...	6,500
Azov	2,800	*Weehawken* ...	3,700
Clematis ...	4,000		

Besides, they contracted for the tank sailing vessels:

Hainaut ...	2,500	*Unionen* ...	2,500
Ville de Dieppe...	1,850		

In those days Liverpool came next to London in importance as an oil port. It pioneered the business which, in more recent times, was greatly increased in volume by the splendid facilities offered by the Ship Canal and Trafford Park Estate, and the incidents and keen rivalry of those early days would, if adequately described, occupy several chapters of a work of this description.

One of the oldest firms engaged in the oil trade on the Mersey is the one which is so well known as Meade-King, Robinson & Co. This was founded in 1867 by the late Mr. Joseph Fletcher Robinson, and the present partners, Messrs. Richard Robert Meade-King, Richard Robinson and William Smellie, joined it at different times since that period.

The firm commenced business in Liverpool as general produce brokers, but from the commencement took a prominent part in the distribution of petroleum products. At first the trade was confined almost entirely to illuminating oil imported in barrels from the United States. The sampling and inspection of the various imports formed a large part of the business, and it was their success in picking out the best oils for their friends in the interior that first gave them the lead in petroleum distribution from Liverpool.

The condition of the trade and the prices of refined petroleum have greatly altered since the seventies. Two shillings and 2*s.* 2*d.* per gallon was paid for thousands of barrels during the winter of 1876. It was considered quite *infra dig.* for the brokers in Liverpool to do business in less than five barrel lots. Refiners who at one time supplied the exporting merchants of New York and Philadelphia themselves look after the five gallon buyers in the United Kingdom and are only too glad to get 4*d.* to 5*d.* per gallon.

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Petroleum spirit for varnish making and cleaning purposes, also for the "sponge" lamps, which have now entirely disappeared, was a product to which the firm gave early attention. In 1878 they commenced the distribution of mineral lubricating oils, which now forms a leading feature of the business. Residuum, paraffin scale and wax followed. During recent years the firm have done a large business in "Giant" and "Ariel" motor spirit, and gas oil for the manufacture of carburetted water gas has also become a leading feature of the business.

From 1900 to 1905 the firm acted as managers for the Consolidated Petroleum Company for the Liverpool and Manchester districts, the company having taken over Nobel's business for refined petroleum and gas oil only; but, at the end of the first period of five years for which the arrangement was made, it came to an end and Meade-King, Robinson & Co. are now independent importers of Russian and American refined petroleum and gas oils. They control tankage in Manchester, Liverpool and Birkenhead, own their own railway tank cars, and have inland depôts for distribution.

Meanwhile the firm of Nobel had several vessels built, the *Blesk* being one. Some of these were transported in sections through the canals in the interior of Russia and down the Volga to the Caspian, where they were put together and proceeded to Baku. These vessels were built from the designs of Col. H. F. Swan. The hold was divided by a middle line longitudinal bulkhead, and also by a series of transverse bulkheads, into compartments, each being fitted with one or more trunkways or expansion and filling tanks. The ballast tank was conical in section, and by this arrangement the oil tanks could be most thoroughly drained. In the event of there being any leakage into the ballast tank, it was filled with water and the oil floated up the midship trunkway, from whence it could be pumped back into the main tank. It was discovered that in practice this was not attended with good results, because when the vessel carried kerosene cloudiness resulted. Col. Swan did not, however, advise the use of ballast tanks, and when he designed the *Lumen* and *Lux* there were no ballast tanks, excepting on the ends.

Another plan for improvements in the construction of "navigable vessels for carrying liquids in bulk, including cargoes of a volatile character, such as petroleum, turpentine, and the like," was proposed by Col. Swan. He divided the hold by a middle line longitudinal bulkhead, and further sub-divided it by a series of transverse bulkheads into compartments bounded at the top either by the vessel's deck or a specially fitted platform. As in some of the Caspian steamers, the oil extended to the skin of the vessel, and to each compartment he fitted one or more trunkways, either circular in section or of any other convenient form, partially filled to ensure the corresponding compartment being full, and also providing for the contraction or expansion of the oil. One feature of the method was an arrangement for recording the height at which the liquid stood in the trunkway; it floated on the liquid and a graduated rod attached to it passed up through a stuffing box in the cover. A small pipe in the cover of the trunkway permitted the vapour to escape. By a suitable arrangement of pipes each compartment was capable of being separately filled or emptied. To provide for any leakage through the end bulkhead of the compartments a well was formed on the fore side of the boiler space, and arrangements were made to enable the liquid to be pumped back into the trunkways.

In 1889 Mr. Lennard had the *Atilla* built by Messrs. Craggs & Sons, and this vessel is still running as the *Margaretha*. The engines are aft. Her builders considered that this ensured continuity of structure throughout the main portion of the heavily stressed part of the vessel, especially of the middle line bulkhead, dispensed with the problem of carrying the shaft through the tanks and the weight of the tunnel, reduced the number of cofferdams, and simplified the pumping arrangements. This type of vessel must not have too fine a run aft if a good cargo is to be carried, as the machinery, and indeed all weights, have to be kept well aft or down the ship goes by the head. The important matter of trim had to be carefully calculated in the case of the *Atilla*, and careful designing was most necessary to find easy and safe stowing room for the oil (44 to 45 cubic feet per ton). It was found that a strong ship was obtained by forming between the spar (or upper) and main decks central trunk feeders and reserve wing bunkers, which ran the whole length of the tanks.

The trunk feeder in this form allowed a certain margin in the weight of oil carried, without appreciably altering the stability, which would, of course, be the case if the oil in a tank fell below the main deck. This was found to be useful, because the Board of Trade required a greater freeboard in an ordinary winter than in the summer, and in the North Atlantic still less oil could be lifted. (As I point out in a later

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chapter, this difference in freeboard was counterbalanced to a certain extent by the lower specific gravity of the American oils, which are about 2 per cent. lighter than Russian, roughly speaking. The two trades are thus partially self-regulating with respect to the cubic capacity of the tanks.) In the *Margaretha* the sides of the trunk form a continuous girder and keep the two decks well connected. Water ballast is fitted aft. Ballast is pumped in when the bunkers are low and keeps the vessel in proper trim. The transverse bulkheads are fitted about 22 ft. apart. At the time of the building of this steamer Mr. Craggs said :—

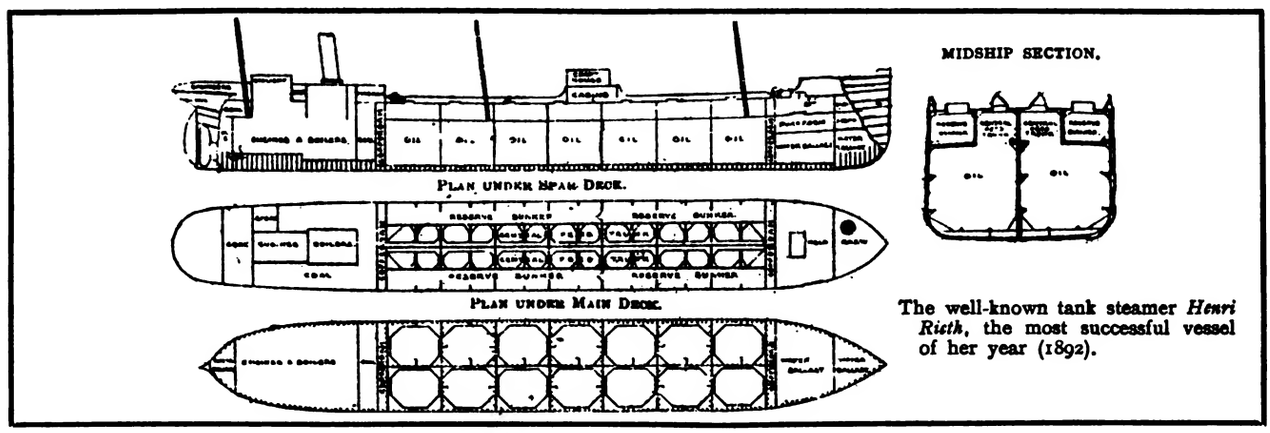
"I have often been told I put my cross-bulkheads too near together. It would be, of course, much cheaper to put fewer tanks into the ship ; but I adopted this rule after much consideration, and the result has fully justified my method. I am of opinion a great deal of the overstraining which has been found—especially in very large craft—is simply due to placing the bulkheads too far apart. I know of vessels 50 to 60 ft. longer than the *Atilla* having no more transverse bulkheads."

A tanker should have a good beam to enable her to stand while her tanks are being filled or emptied. This gives her a tendency to be rather a heavy roller and calls for nice lines to ease her movements at sea. The tiers of shelf girders or stringers keep the vertical stiffeners up to their work and ensure stability under all conditions.

After the *Atilla* came the *Lux* (built in the Mediterranean and lost off the coast of Greece in 1891), and the *Northern Light*, which was sold to the Anglo-American Oil Company. The *Hotham Newton* was built for Mr. Lennard by Messrs. Raylton, Dixon & Co., and the *Henri Rieth* by Messrs. R. Craggs & Sons in 1892.

The *Henri Rieth*, still running, was very similar to the *Atilla*. She has more space aft, left available for permanent bunkers, and, therefore, less trimming to do at sea. The accommodation is placed amidships in a bridge house, and the addition of a forecastle gives a drier ship at sea. Large water ballast provision is introduced in the fore-hold, and the pump room is also put in that part of the vessel, giving much more room. This vessel has a capacity for 3,000 tons of oil besides bunkers.

Mr. Lennard's firm subsequently purchased the *Prudentia*, which was built by the Palmer's Shipbuilding and Iron Company for Mr. Alfred Suart in 1889. This is perhaps the most successful of the tank steamers launched in the eighties. The vessel is fitted to carry general cargo, and has been most successful, both when running east with oil and returning with general merchandise. She was an expensive vessel to build, but the work she has done has justified the desire of her first owners that she should be the best tank steamer of her time.



The well-known tank steamer *Henri Rieth*, the most successful vessel of her year (1892).

The *Mexicano* was built by Messrs. Laing & Co., Sunderland, for the King Steamship Line, of Middlesbrough. Her engines are amidships. One reason given for this was that in the ordinary tanker it is impossible to cross shallow bars with even one or two tanks filled. The weight of machinery and coal aft keep her always dragging a lot of water as she goes down by the stern.

This vessel can be easily kept on an even keel. She will carry oil one way and general cargo or molasses the other. The feeders serve also as hatches for cargo, a portion of the hatch being movable, leaving clear 9 ft. by 7 ft. There is no trunk feeder and the oil is carried right up to the weather deck. This plan of using the full depth and breadth of the vessel near midships keeps the weight from getting pushed

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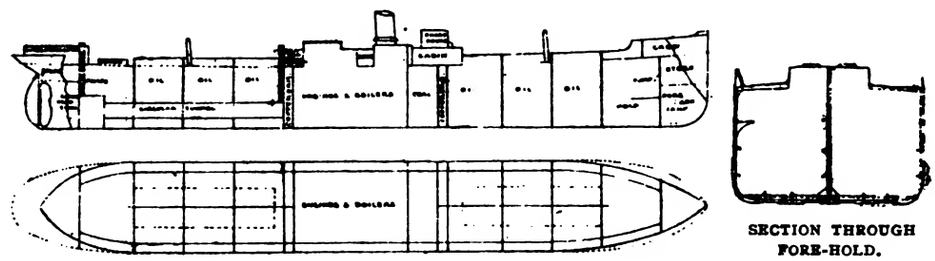
too far into the ends of the ship, in which case the pitching would be very heavy at sea. This type of vessel seems to be exceedingly well suited for the purpose of combining the ordinary cargo boat and the tanker, as she has good square holds which are easily accessible.

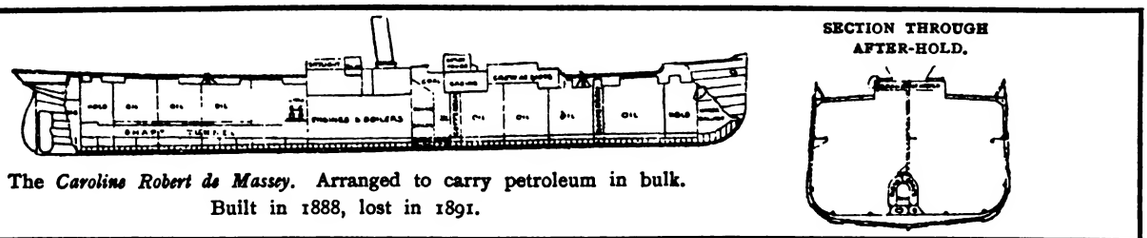
In this vessel, means of rapidly changing the air in each compartment are provided. As the objectionable gases lurk at the bottom of an emptied tank, tubes about a foot in diameter are placed at the small



The *Mexicano*. It was vessels of this type which enabled shipbuilders to contend that the danger connected with their working had been very much exaggerated. It having been recognised that the heat of the sun's rays striking directly upon the oil-tanks in hot climates was a source of danger, the *Mexicano* was provided with awnings fore and aft.

oil hatches, reaching nearly to the bottom of the vessel; a movable cowl, having a reduced mouth, is fitted when required, and steam, turned on through a nozzle, is directed upwards so that foul air is quickly exhausted.

The design of the shaft tunnel deserves special notice. The tunnel is a huge cylinder about 6½ ft. in diameter and built of ½ in. steel plate, all angle stiffening being thus dispensed with. The only communication is by means of ladders trunked up to the deck. At each end the shaft is bushed and passes through close-fitting collars kept tight with good glands. The isolation from the engine and boiler space is complete.



The *Caroline Robert de Massey*. Arranged to carry petroleum in bulk. Built in 1888, lost in 1891.

About 1888, some of the most brilliant organisers of the Standard Oil Company—Mr. Libby, Mr. Bliss, Mr. Tilford and Mr. Jameson—appeared in Europe for the purpose of extending the markets for American oil and arranging for more regular and increased shipments in tank steamers. It is an old story—and one which has been told in some quarters with much bitterness of feeling—how the Standard's representatives amalgamated some of the most powerful concerns on the Continent and purchased the following steamers: *Paris*, *Geestemunde*, *Heligoland*, *Europe*, *La Flandre*, *La Campine*, *Bremenhaven*, *Burgermeister Petersen*, *Charlois*, *Energie*, *Gut Heil*, *Chester*, *Ocean*, *Minister Mayback*, *Willkommen* and *Gluckauf*, and the sailing ship *Hainaut*,* originally built for Messrs. Speth & Co., of Antwerp.

This was a record deal in oil-carrying tonnage, and it very naturally created a great deal of interest amongst the oil men of that day.

At that time there was a huge refining industry in America, and the gigantic pipe line systems reached to tide-water and poured kerosene into oil-carrying vessels for transport to all parts of the world. The largest works were at Hunter's Point and Newtown Creek, Long Island; Bayonne, New Jersey; Point Breeze, at the junction of the Delaware and Schuylkill Rivers, Philadelphia; Thurlow, on the Delaware

* This sailing vessel, flying the flag of the Anglo-American Oil Company, is still running, and in one respect she is unique—she is the only sailer regularly employed in the Transatlantic oil trade. She is one of the fastest tank sailers, a splendid ship at sea, but an unpopular one with those who sail in her on account of the rapidity with which her cargoes are discharged. So perfect is her equipment that her oil is pumped out in as many hours as it takes days to discharge the general cargoes of large sailing vessels. She is usually a very few days in port, and can make as many as four round voyages between New York and Antwerp in a year—a good record for sail against steam, and one that has certain financial advantages.

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River, a few miles below Chester, and near Baltimore, Maryland. The most extensive and best equipped were located at Bayonne, where the Standard Oil Company had its own extensive piers and all the necessary facilities for loading the largest tank vessels afloat. Formerly, the largest refineries were situated in the oil regions, or, at least, upon the line of the railways. They were usually built upon the sides of hills, the storage tanks being placed upon the highest points to admit of the crude flowing by gravity to the stills. A few large establishments were on the banks of the Allegheny River, not far from the busy and prosperous oil-made town of Pittsburg.

THE yield of oil during 1860, 1861 and 1862, although small compared with that subsequently produced, was far in advance of the actual demand. In the "Derrick's Handbook of Petroleum," I find this memorandum for October, 1860—"So much oil is produced it is impossible to care for it, and thousands of barrels are running to waste in the creek. The surface of the river is covered with oil for miles below Franklin. Fears

are entertained that the supply will be soon exhausted, if something is not done to prevent the waste." In 1862, oil sold for ten cents per barrel. There was practically no export demand, and the home trade for want of suitable lamps was in its infancy. From a variety of causes it was difficult in those days to estimate the annual yield of petroleum; the early methods of transportation in bulk, boats and barrels tended greatly to the confusion of the estimates.

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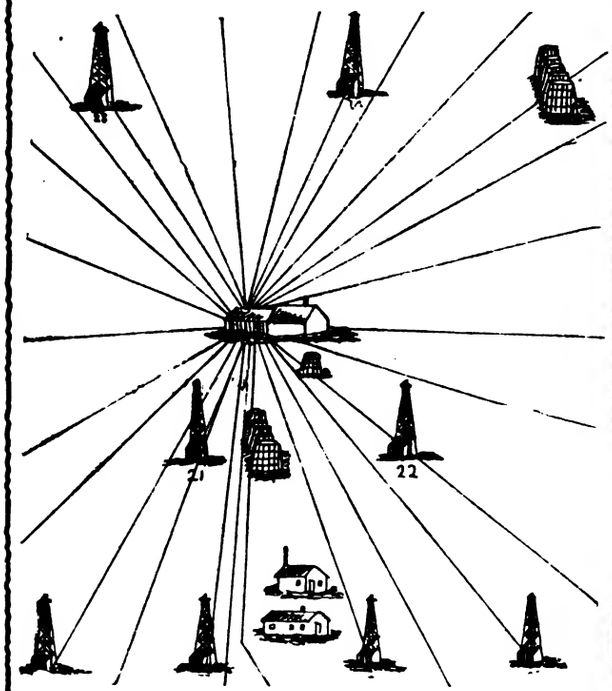

WE have watched its growth from the sale of a few barrels to millions of barrels. How much it has promoted the happiness and comfort of the multitudes upon whom it has shed its mild and beautiful light cannot be estimated.

BENJAMIN J. CREW, 1886.

OIL is a wonderful product of nature. No substance under the sun yields such a number and diversity of useful articles. The list (nearly two hundred) is a revelation. Wax tapers at St. Paul's and Brompton Oratory, sacred oils on the altar at the Vatican and candles that flicker in countless humble homes are the products of Russian, American and Galician crude oil.

J. D. H.

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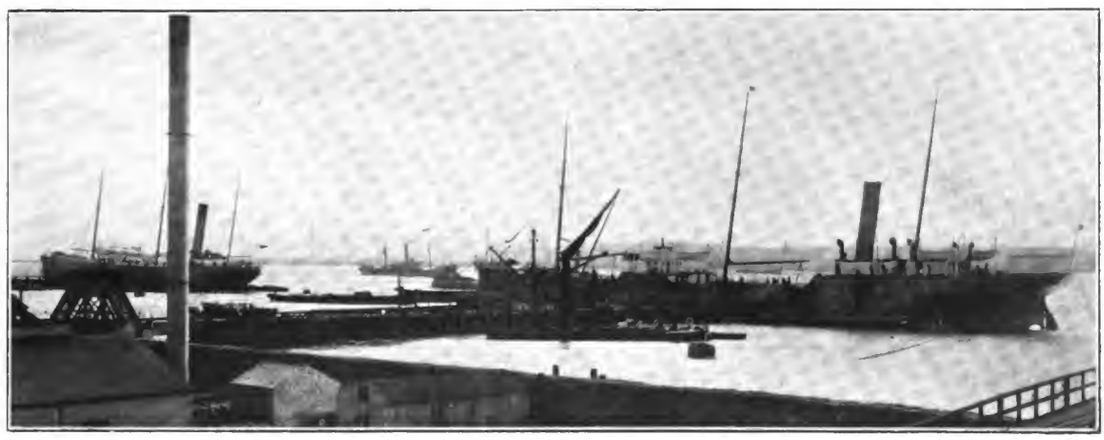
RIVER SCENES AT PURFLEET-ON-THE-THAMES.

Oil-Carrying Vessels at the Wharves of the Anglo-American Oil Company.

ON THE RIGHT, ONE OF THE STANDARD OIL COMPANY'S BARGES DISCHARGING AMERICAN OIL.

ON THE RIGHT, THE ANGLO-AMERICAN OIL COMPANY'S TANK STEAMER *TUSCARORA*.

ON THE LEFT (CENTRE), DECK VIEW OF THE TANK STEAMER *COL. DRAKE*, WHICH HAS MADE A NUMBER OF TRIPS ACROSS THE ATLANTIC TOWING OIL-CARRYING BARGES.



THE *SUWANEE* (ON THE LEFT) AND *POTOMAC*, BOTH OWNED BY THE ANGLO-AMERICAN OIL COMPANY.

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CHAPTER III.

The Anglo-American Oil Company's Fleet. Some Notable Records.

BY this time (1888) there was an increasingly keen competition in the commerce of petroleum in Europe, and the important shipping transaction, referred to in the previous chapter, created a great deal of excitement at the chief oil-importing ports on the Continent as well as in London oil circles. This deal marked the advent of a new era in the business of importing American oil; it practically laid the foundation for the start of the European-American bulk oil organisation which works so satisfactorily at the present time.

This same eventful year—the one in which one shipbuilding company alone, Messrs. Armstrong, Whitworth & Co., built a dozen tank steamers—witnessed the formation of the Anglo-American Oil Company in London. This was just two years after the first cargo of Russian bulk oil had been discharged in this country. The company started business at 16, Great St. Helens; afterwards went to Dock House, off Billiter Street; and then, moving a third time (1890-1), all departments went over to the present address, 22, Billiter Street.

It has always been acknowledged in the City that those who organised the "Anglo" were men of consummate ability; they certainly had business ideas which commanded admiration, and it was early seen that their enterprise and zeal could only have one result—the establishment of a great and prosperous business house with influential branches in the provinces.

To-day the company controls the most important oil-distributing organisation in these islands, and I suppose there are few commercial or industrial concerns that would pretend to match their systems of organisation and administration against those which have been so successfully worked by this company. The organisation consists of quite a number of distinct branches, and, although very little indeed is known of the methods of the management, it is generally recognised that the huge business of importing and distributing the different kinds of American illuminating oil, petrol, etc., in city, town and country is one which comes marvellously near to an ideal solution of the ever-changing problems of supply and demand, and in every way meets the needs of the people. The system ensures continuity of supply; indeed, there is no demand for "the light that fails not" which this company cannot meet, so complete has the organisation become during the nineteen years it has been in existence.

Like the other distributing companies, the "Anglo" has experienced considerable difficulty in establishing some of its distributing branches at great centres of population. The business has not been built up without difficulty. Occasionally there have been displays of antipathy to the business by local authorities, and in the early days of its existence some hard fights had to be fought by the company before local prejudices were overcome, and public men were convinced that the oil business is worth something to the rates, beneficial to the people, and quite as safe as any of the local industries.

Much of its success has been due to the methods of the marine transport of the oil—to the vessels in which the oil is brought to this country. The "Anglo" has the largest fleet of oil-carrying vessels flying the British flag, owns the largest tank steamer in the world, and holds the records for oil storage accommodation and the number of tank waggons and cars.

A list at the end of this chapter shows that the company has a fleet of nineteen ocean-going steam tankers, four case oil steamers, and sixteen sailing vessels. The company has always shown a great partiality for Clyde-built oil-carriers, both steam and sail. The smallest steamers have from six to eight compartments, each holding about 85,000 gallons; but as much as 73,500 barrels in bulk (12,500 tons), of which over 11,000 tons is oil in tanks, and 1,500 tons either coal or oil fuel, are carried by the *Narragansett*.

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In the sailing section there are a number of fast and beautifully-modelled vessels, including the four-masted sister ships *Brilliant* and *Daylight*. These crack sailers have tanks which enable them when they have discharged oil to take in water ballast, an arrangement which facilitates discharging and accounts for their exceptional stability when light.

In a later chapter I give particulars of new oil-carrying vessels which are being built at the present time, and these show that this company is well to the front, both in the matter of new tonnage and early delivery.

The records of the fleet show that those who hold commands are men of exceptional ability and experience; men who not only know how to navigate a ship, but who have a practical knowledge of how to handle all kinds of oil in every part of the world. Some have splendid records in this specialised work on the Atlantic, and it is to the credit of them all that not one of their number has lost a tank steamer.

The marine oil-carrying branch of the company's business has been built up contemporaneously with the chief storage installations at Purfleet, and the development of the distribution facilities in the metropolis and the provinces. From the start the company has adopted the latest methods of handling oil ashore and afloat, always keeping well ahead of the times, and the entire system is founded on a cardinal idea of the directors that the plan which ensures safety in storage and dispatch in transport guarantees the increasing prosperity of a business of this kind.

The marine part of the company's history is uneventful; it is merely a record of safe and successful work. The first tank steamers built were the *Bayonne* and *Manhattan*. In the case of these steamers the far-seeing representatives of the company made it plain that they had their own well-defined ideas, and refused to be dictated to by any of the shipbuilders from whom they secured tenders. They had designs well ahead of the times. Competition resulted in the order for the *Manhattan* going to Messrs. J. D. Dunlop & Co., while Messrs. Inglis got the order for the *Bayonne*. The work at the yards started in 1889, and the only remarkable incident about the launches was that the *Bayonne* entered the water sideways.

On their first trips the *Bayonne* was commanded by Capt. Payne (who rose to be the commodore of the fleet, and died only two years ago, a very short time after he took charge of the *Narragansett* on her maiden trip across the Atlantic), while the *Manhattan* was taken away from the Clyde by Capt. Leighton, also deceased. I may say that I met the late Capt. Payne on several occasions, and remember that he once told this story. He was in an Indian port in command of a sailing ship when a fortune-telling tribesman gave him a forecast of his life. "The fellow told me," said the Captain gravely, "that the day would come when I would command a very large steamer in a peculiar trade." And then, quizzically—"Now, I would just like to know whether that knowing fellow in India had his eye on the *Narragansett*. It really looks very much like it, doesn't it?" And the company laughed heartily, without anyone being able to say just in what way the popular old commodore expected his story to be taken.

Of this magnificent type of shipmaster—one of the old school that always started in sail—it was once said by Mr. James McDonald "that he commanded the first vessel the company launched on the Clyde, and had gone from one steamer to another as they were launched until he finished with the *Narragansett*," his last command, alas!

One of the last acts performed by Capt. Payne before he gave up command of the *Narragansett* was to pick up the French steamer *Gallia* and tow her into Halifax half a knot faster than the disabled vessel could steam.

The ever young and resourceful Capt. Scott, formerly in command of the *Tuscarora* and other Anglo-American steamers, succeeded Capt. Payne, and has now had two most successful years in the huge oil-carrier. He came into oil in the days of the old Kerosene Company, when transport in this country was a primitive and unpopular business, entered the employ of the "Anglo" when they took over some of the vessels of that company, and, although well known in most of the world's great oil ports, makes no secret of the fact that he favours New York, the Thames, and the Tyne—the last named because it is his native river and the place where the *Narragansett* bunkers and starts on each round voyage. Capt. Scott is more than a commander; like Capt. Brown (of the *Caucasian*) and some other masters who are in the oil trade, he is not content to let his duty end with the navigation of his vessel, but takes a real practical and constant interest in the safe and proper handling of her cargoes.

To return to the history of the fleet, I have only to repeat that I have found it barren of romance; the

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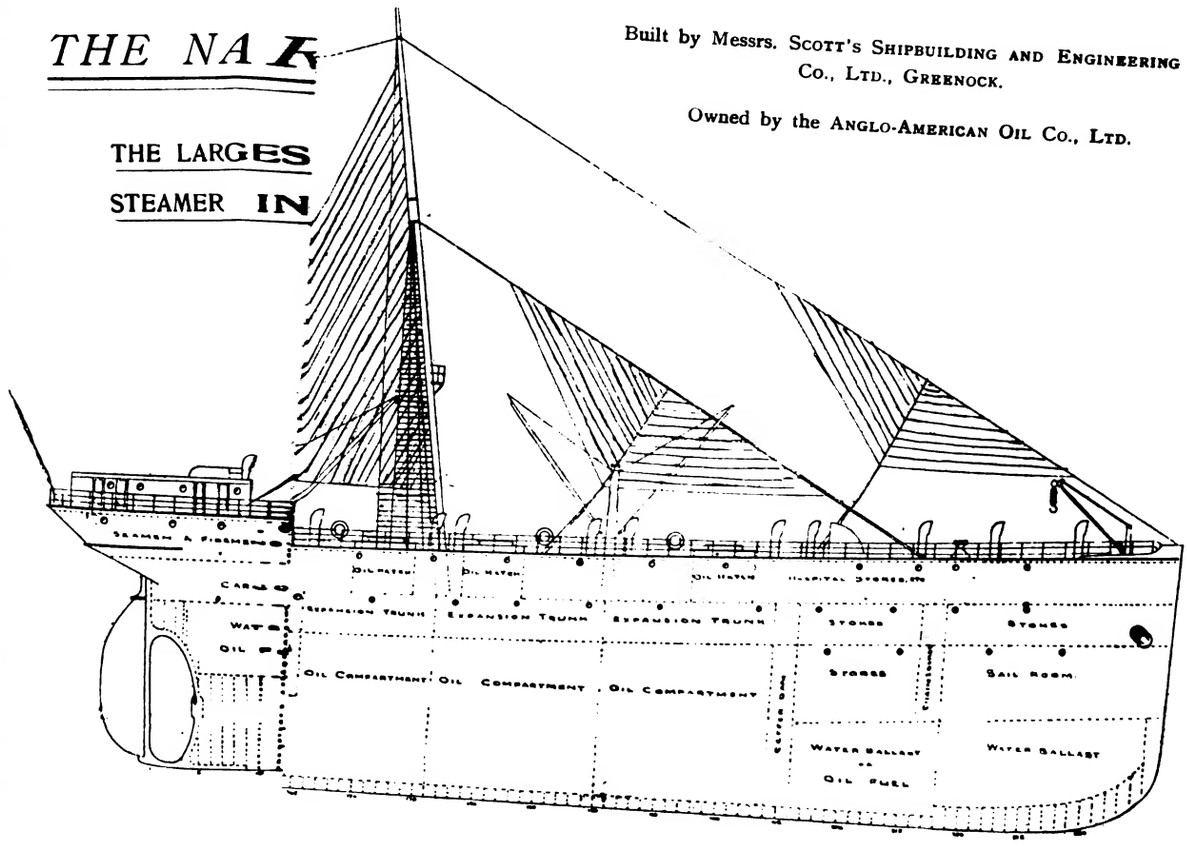
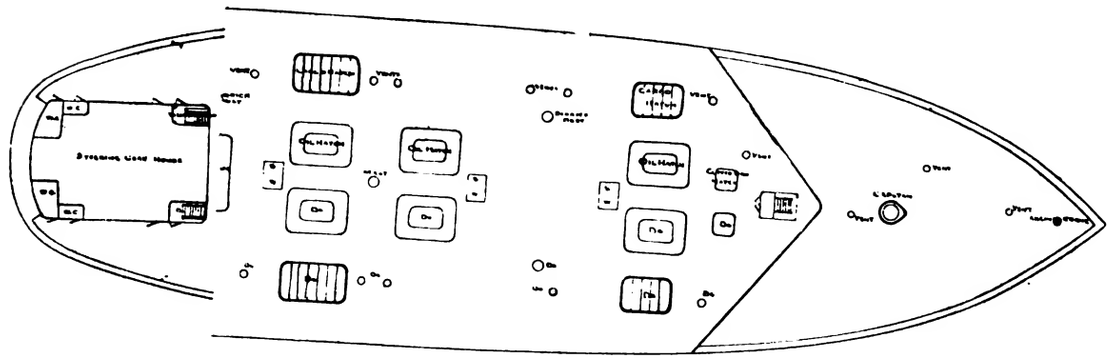
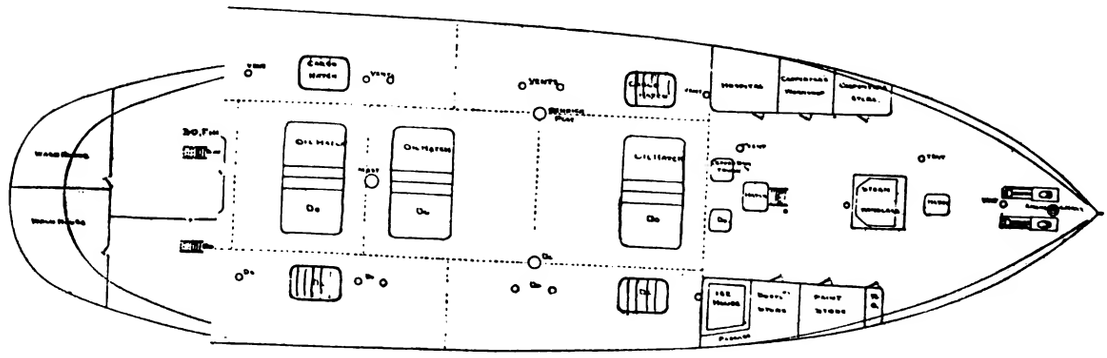
THE LARGES
STEAMER IN

Built by Messrs. Scott's Shipbuilding and Engineering Co., Ltd., Greenock.

Owned by the Anglo-American Oil Co., Ltd.







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record which it possesses is one of safe and successful transport, with nothing more in it than an occasional stormy passage and a display of clever seamanship.

The medium-sized tankers have all done splendid work. The *Delaware*, a small tanker compared with the record carrier of the fleet, was said, when she was launched by Messrs. Dunlop & Co. (1893), to "exemplify the most modern improvements in petroleum tank steamers." This was owing to her most superior system of compartments.

At least one interesting record has been made by the *Potomac*, built by Messrs. A. and J. Inglis (she left the Clyde on September 8th, 1893) and a remarkably fine sea boat and an economical and safe oil-carrier. When her owners approached the Port and Docks Board at Dublin for permission to erect the buildings and plant to work the tank system, the board undertook to introduce certain improvements and let the company have a tract of land on the north side of the Alexandra Basin. Six months before the arrival of the *Potomac* with the first cargo of bulk oil, the work of putting up new buildings, pumping plant and storage tanks (each capable of holding 30,000 barrels of oil) was commenced, and it was stated at the time "that a feature in connection with the new installation would be that all barrels used in the Irish business would be made in Dublin, instead of imported ready-made." The *Potomac* discharged the first cargo of bulk oil at Dublin, and her arrival on February 2nd, 1889, with 1,206,200 gallons of illuminating oil gave the greatest satisfaction to the municipal and port authorities, who were delighted to witness the inauguration of a new trade and the threatened extinction of the old barrel system.

On September 18th, 1903, the *Potomac* delivered her hundredth cargo of bulk oil, having crossed the Atlantic two hundred times in ten years, during which period she discharged nearly half a million tons of oil. Up to the present (June, this year) she has completed one hundred and thirty-three voyages, keeping up the good average of the runs which she made when she was one of the crack oil-carriers of the Atlantic. I suppose she has made more Atlantic voyages than any other tank steamer.

In 1899 the company purchased the *Kasbek* and *Darial*, and in 1900 the *Elbrus*, sister ship of the *Kasbek*, was also secured. In the new employ these steamers are known as *Suwanee*, *Genesee* and *Ottawa*. Built by Messrs. Armstrong, Whitworth & Co., they are still running in the American oil trade.

An example of the quickness with which an oil-carrying vessel can be converted into an ordinary freighter was provided by the first voyage of the company's *Seminole*, built by Messrs. Furness, Withy & Co., of Hartlepool, some five years ago. She is 414 ft. in length, her machinery is aft, and provision is made under the engines and boilers for water ballast, while the fore and aft peaks and double bottom under the fore-hold are also available for ballast.

She has fourteen oil-tight bulkheads, with oil-tight centre division through oil tanks and expansion trunks. There are in all sixteen separate oil tanks. Trunks are fitted above each oil compartment to allow the oil to expand with the increase of temperature. The pump room at the after end of the oil tanks is fitted with two separate oil pumps for discharging the oil cargo. A powerful fan is fitted for exhausting foul air from the oil compartments and making the spaces thoroughly suitable for the carriage of ordinary cargo when required. The construction of the vessel throughout received special attention, very heavy shell plates, deck plates, etc., being fitted to minimise the risk of leakage of the oil cargo. A large cargo hold is fitted at the fore end of the vessel, and provision is also made for the carriage of cargo along the expansion trunks as well as in the poop. The engines and boilers are by Messrs. Richardson, Westgarth & Co., Ltd., Hartlepool.

She left the Tyne on July 27th, 1904, on her maiden voyage to Novorossisk to load bulk oil, a cargo of nearly 7,000 tons, for Calcutta. Having discharged at Calcutta, she loaded jute for Dundee, at which port she finished discharging on November 21st, having done the round voyage well within four months.

The company's successful steamer *Tuscarora* is the prototype of the *Narragansett*. These vessels are built on the same lines, and, as I have already stated, the *Narragansett* is the largest and fastest tank steamer afloat. She was completed by the Scotts,* of Greenock, in 1903, and was their first oil-carrying steamer.

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* The firm was founded by John Scott in 1711. The family has maintained an unbroken connection with the shipbuilding industry for 200 years, a record that is almost unique in the history of Western manufactures. To-day the descendants (sixth generation) worthily maintain the high traditions which have accumulated during the intervening two centuries.

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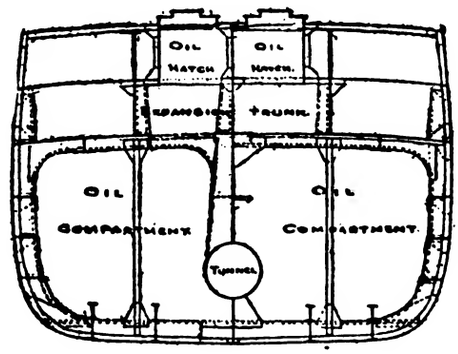
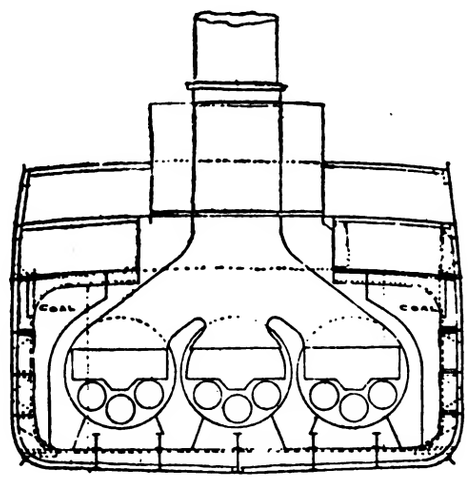
THE NARRAGANSETT.

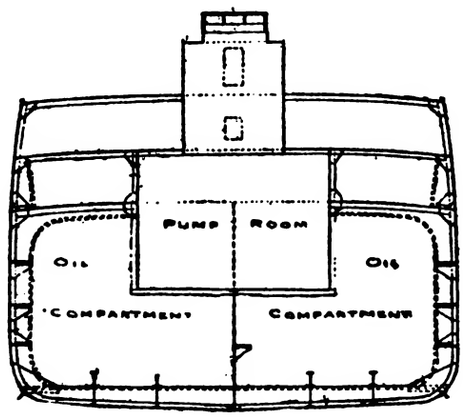
SECTION IN WAY OF OIL HATCHES AT FRAME NO 60.



SECTION THROUGH BOILER SPACE AT FRAME NO. 125



SECTION IN WAY OF PUMP ROOM AT FRAME NO 182



The building of this huge vessel in that year, when the shipping branch of this business was far from prosperous (it was one of the years when many tank steamers were lying idle, owing to the failure of the Texas oil export business to come up to English expectations), was not only testimony to the enterprise of the London company, but showed in a most significant manner the stability of the Anglo-American oil trade and its freedom from those commercial influences which are known to interfere with the success of similar companies.

The steamers of the "Anglo" are named after American rivers, and this has led to their being known as the "River" Line. The *Narragansett* is named after a watering-place near New York.

The *Narragansett* is remarkable in several ways; not only is she the largest bulk oil-carrier afloat, but she makes a record as the largest vessel built on the lower reaches of the Clyde, and stands first for size in the dry docking business on the Tyne.

She has a length between perpendiculars of 512 ft. and over-all of 531 ft.; the beam is 63 ft. 3 in., and the depth, moulded, 42 ft. Her gross tonnage is about 11,000 tons, and the dead-weight carrying capacity on a draught of 27 ft. is 12,500 tons, of which over 11,000 tons is oil in tanks, and 1,500 tons either coal or oil fuel. When fully laden her displacement is about 21,000 tons. She belongs to Lloyd's A1 three-deck class, with a complete shelter deck, but it is obvious that in many respects she is in excess of Lloyd's requirements, which are particularly stringent in the case of tank steamers.

The combination of the great size, and the structural arrangements peculiar to oil-carrying vessels, presented numerous problems to designer and builders, and the fact that these were successfully solved is considered most creditable to Messrs. Scott & Co., seeing that she was their first order of this description, and entitled them to be placed on the list of shipbuilding concerns competent to turn out this class of work. Owing to the number and arrangements of the subdivisions, she is practically unsinkable under any circumstances, and, I should say, the safest vessel engaged in the Transatlantic trade. The owners spared no expense in securing every advantage that their great experience in the building and running of this class of ship could suggest.

There are no less than eighteen 'thwartship bulkheads, and these compartments are subdivided by longitudinal bulkheads, forming in all twenty-seven separate compartments below the main deck—a

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wonderful guarantee of stability and safety. With one or two exceptions, these compartments have been made absolutely oil-tight. The number of rivets used in construction of the vessel was over 1,250,000.

The *Narragansett* has her machinery amidships, which necessitates the expensive, but most advisable, arrangement of a circular tunnel passing through eight separate oil compartments astern of the engine-room. Access to the tunnel is obtained from the shelter deck by two separate trunks, one at each end, both of which also pass through the oil tanks. The oil tanks proper, sixteen in number, are all below the main deck, eight being forward and eight aft of the machinery space. Between the main and upper decks are the expansion tanks, and four smaller oil compartments, to be used when the vessel is loaded down to her summer freeboard. There are four cofferdams of oil-tight construction, and the bunkers and deep ballast tanks are also made oil-tight for use as oil bunkers, should it be decided to adopt oil as fuel. Two oil-tight pump-rooms are fitted, one forward and one aft of the machinery space; these are entered from the upper and shelter decks. There are four oil pumps capable of discharging the oil at the rate of 900 tons per hour, or the whole cargo in about twelve hours, a discharging feat which it would be scarcely possible for any general cargo steamer in the world to accomplish, no matter how numerous her discharging derricks might be. Suctions from the pumps are led to all the tanks and cofferdams, and these and all the discharging arrangements are of the most perfect description. There is an excellent pumping installation of the "Snow" type on board. Steam pumps are fitted for pumping out the tunnel and the various ballast tanks, which consist of the double bottom under the machinery, the peaks, and a large, deep tank forward.

Any of the oil tanks are, of course, also available as ballast tanks, in the event of the ship requiring to make a light voyage, and this arrangement guarantees safety from many dangers which beset a light ship in an Atlantic gale. Most complete arrangements are made for turning the vessel into an ordinary cargo steamer within a few hours of her employment as an oil-carrier. The thorough cleansing of the oil tanks from oil and gas is essential, and this was so carefully considered that the anticipation of her builders and owners that she will be able to make records in quick conversions to a general cargo carrier, are certain to be justified if ever the change is necessary. Steam connections are arranged to all the tanks for cleaning and fire extinguishing purposes, and a most elaborate system of ventilation has been adopted for clearing the tanks of gas. A large fan, fitted in each of the pump rooms, is connected to each tank by pipes for the supply and suction of air. Large and numerous cowl ventilators are fitted on the shelter deck, with portable pipes leading from them to the oil tanks. The coamings for these pipes on the oil decks are fitted with oil-tight removable covers for use when the tanks are filled with oil. The cargo gear on deck consists of sixteen derricks fitted on "Samson" posts, and nine large and specially designed steam winches. In addition to the centre line of hatches, which communicate by oil-tight trunks with the oil tanks, side hatches are fitted to the upper and lower 'tween decks, which are always available for cargo, even when the oil tanks are full. She has facilities for a spread of awnings, both fore and aft, to prevent the sun heating the decks in very hot weather.

One of the chief characteristics of a most perfect installation of voice tubes, fitted by Messrs. Durham, Churchill & Co., of Sheffield, is their insulation from any part of the vessel which can impart vibration. The fittings insure perfect insulation. As a stand-by to the mechanical telegraph they are invaluable, as not only can they be used if the latter fail, but they can be requisitioned for a variety of purposes, including the giving of orders which are altogether beyond the scope of the mechanical telegraph. A breakdown in the mechanical telegraph when such a huge vessel is steaming full speed, or being worked in a crowded water-way or dock, may be a very serious matter, as, before any messenger could be sent from the bridge to the engine-room, the ship would have covered a considerable distance, or got into trouble amongst crowded shipping. Equally, in the event of any break-down in the engine-room rendering it impossible to fulfil any order received from the bridge, it is of the utmost importance that the navigation officer should be informed of it immediately, and this, of course, can be accomplished by means of these tubes. The patent is the invention of Rear-Admiral Henry Rose.

The *Narragansett* is an exceptionally fine job on deck, where the high finish of everything is obvious to those who visit her. Her 'tween decks are lighted by side-lights through the ship's side, so that she can, if necessary, be readily made available for carrying cattle or troops; indeed, it may with truth be said that no vessel in the world is equipped to run in such a multiplicity of trades.

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The engine-room is a huge place, with the light penetrating into every corner. The machinery, constructed by the builders, is of very massive design, and consists of a set of triple-expansion engines, and six large single-ended boilers, capable of generating steam to develop over 5,500 i.h.-p., which will propel the vessel at a greater speed than 13 knots. The cylinders are supported by six "split" columns, three of which carry a circular condenser, formed of steel plating, of large cooling surface, and supplied with water by an 18-in. centrifugal circulating pump, driven by two independent engines. There is a complete installation of auxiliary machinery, including two sets of slow-speed boiler feed pumps, feed heater and evaporator, feed filters, and one of Crampton's Atmospheric Silent Ash Hoists (self-tipping) in each stokehold. In a vessel with such a great depth of stokehold, inventions like these are not only necessary, but they are labour-saving to quite a humane extent.

The boilers have a working pressure of 200 lbs. per square inch, and are placed three abreast in two stokeholds. They are worked under natural draught, and the funnel, which is 15 ft. diameter, rises to a height of 105 ft. above the grate bars. The shafting is much in excess of Lloyd's requirements, and the propeller (20 ft. in diameter) is fitted with four adjustable bronze blades.

For the perfection and success of the steamer the company are much indebted to Mr. Blair, who played an important part in the planning and carrying out of the work. Anything that Mr. Blair does not know about steamships is not worth knowing. In superintending the work Mr. Blair was ably assisted by Mr. Morton (the chief engineer of the vessel) and Mr. M'Ewan, who superintended the construction of this and many other oil-carrying vessels for the company. Concerning her, Mr. Blair has said: "There is not a finer vessel of her class in the world. I know almost every oil vessel afloat. None of them will compare with the *Narragansett;* they have not the accommodation; they have not the same good fittings; and the owners have not spent the same amount of money in order to get the same first-class job."

The anticipations of Mr. R. Sinclair Scott that she would have a most successful career, and repeat to the fullest extent, when in the actual and peculiar service of the company, the excellent results of the first day's trial, have been already fulfilled. Steaming, she has given uniformly good results with ordinary coal, and some of these are shown in the following table :—

Voyage No.	Coal, Indicated Horse-Power per Hour.	Total Coal on Voyage.	Coal for Boilers only.	Sea Miles on Voyage.	Cargo Carried.	Average Speed.	Horse-Power on Voyage.
	lb.	Tons.	Tons.	Miles.	Tons.	Knots.	I.H.P.
15	1·60	918	822	3,447	10,298	10·85	3,713
	1·58						3,900
16	1·59	923	834	3,403	10,289	10·80	3,951
	1·64						3,775
	1·63						3,668
17	1·50	924	836	3,469	10,499	10·40	3,949
	1·53						3,796
18	1·50	847	775	3,441	10,563	11·10	3,937
	1·50						3,720
19	1·44	837	760	3,423	10,570	10·85	3,909
	1·43						3,813
20	1·50	780	707	3,312	10,641	11·50	4,107
	1·32						3,817
21	1·56	846	766	3,330	10,651	10·60	3,909
	1·44						3,870
	1·46						3,746
TOTALS ...		6,075	5,500	23,825	73,511		
AVERAGES	1·51	868	786	3,404	10,501	10·87	3,848

Her best round voyage—the Tyne to New York in ballast trim, and back across the Atlantic to the Thames with a full cargo of 12,000 tons—occupied 27 days; her average one (10½ days) being 12·3, and the homeward run (12 days) 11·5. Shortly afterwards she made 11·9 on an eastward run. She can do the round voyage in the shortest month of the year, and seldom takes longer than a month if she is given an ordinary dispatch.

The company (with Mr. John Usmar as head director) is steadily building and acquiring new tonnage, and developing its storage, barrelling and distributing facilities to meet an ever-increasing trade in all parts of these islands.

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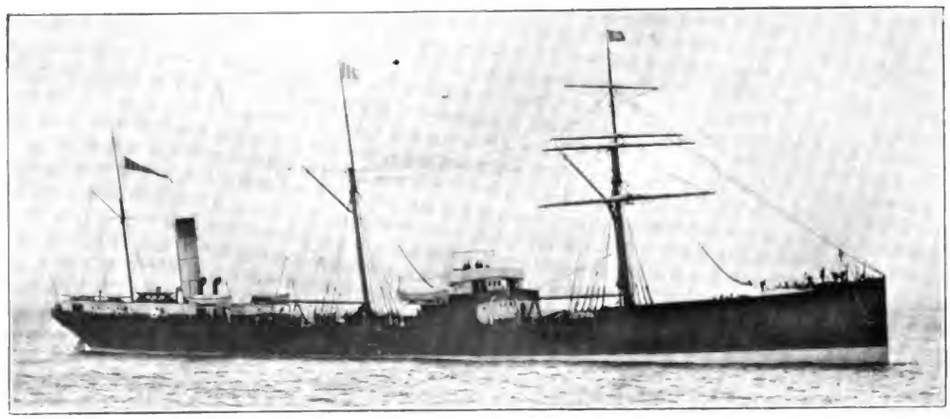
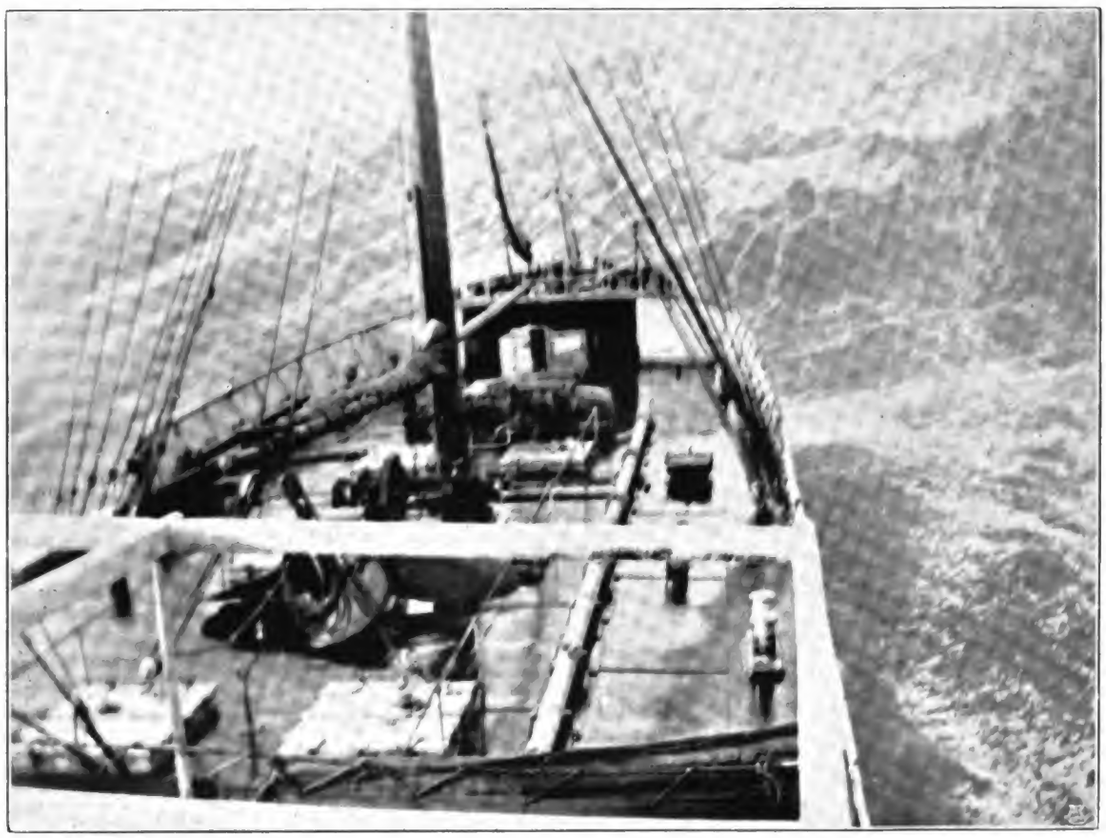


Launched as the *Darial*, this steamer is now the *Genesee*, owned by the Anglo-American Oil Company.



The same company's steamer *Suwanee* in an Atlantic gale. She is one of the best sea boats carrying oil.

This steamer (launched as the *Lucigen*, the second of that name) was this year purchased and renamed the *Cuyahoga* by the Anglo-American Oil Company.

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Oil-Carrying Fleets of the Anglo-American Oil Co.

TANK STEAMERS.

Steamer.	Captain.	Length.	Breadth.	Depth.	Oil Capacity.	I.H.P.
Narragansett	J. D. Scott	512	63·4	32·6	10,975 tons, or 75,600 brls.	4,500
Tuscarora	F. S. Hollinshead	420·4	53·2	29·1	7,250 „ „ 49,800 „	3,300
Chesapeake	W. Gray	370	47·1	27·8	5,200 „ „ 36,000 „	2,500
Housatonic	J. B. Henry	347·4	45·6	27·2	4,725 „ „ 32,500 „	1,800
Delaware	C. Cabot	345	44·3	23·0	4,680 „ „ 32,200 „	2,500
Potomac	T. R. Mackay	345·2	44·2	23·0	4,650 „ „ 32,000 „	2,500
Lackawanna	F. W. Gray	345	44·3	23·0	4,715 „ „ 32,500 „	2,500
Appalachee	P. Nicolls	340	44·2	22·1	4,500 „ „ 31,500 „	1,800
Tonawanda	C. Clarke	330	42·7	28·4	4,300 „ „ 29,800 „	1,700
Weehawken	G. Harding	310	40·2	28·2	3,685 „ „ 25,400 „	1,250
Ottowa	R. G. Tait	309·5	40·4	28·2	3,600 „ „ 24,800 „	1,250
Suwanee	L. M. Wright	310	40·4	28·3	3,575 „ „ 24,500 „	1,250
Genesee	T. H. Albrethsen	310	40·2	28·3	3,720 „ „ 24,900 „	1,250
Tioga	N. Macdonald	276·7	38·0	25·7	2,600 „ „ 18,200 „	1,000
Imperial	L. Morison	200	32·0	14·4	800 „ „ 5,600 „	700
Osceola	S. Hall	140·5	26·1	10·8	300 „ „ 2,100 „	400
Dakotah	W. A. Ross	350	47·0	27·6	5,300 „ „ 36,500 „	2,000
Seminole	Jas. Whyte	400·6	52·2	30·8	6,800 „ „ 47,000 „	2,800
Ashtabula	C. E. Harwood	428	54·7	30·5	7,720 „ „ 53,200 „	3,000
Winnebago	D. Macdonald.	360	49·7	28·7	6,100 „ „ 42,000 „	1,800
Cuyahoga	C. Dyer	370·3	48·5	28·8	6,000 „ „	1,900

CARGO STEAMERS.

These steamers carry oil in cases, and are of the ordinary freight steamer type.

Steamer.	Captain.	Gross.	Nett.	Dead-weight.	Length, feet.	Breadth, feet.	Depth, feet.	I.H.P.
Hudson	C. Fenton	3,679	2,376	6,000	356·0	45·2	18·7	1,650
Seneca	W. Grimes	4,848	3,171	7,850	390·0	52·1	27·0	1,700
Kennebec	C. R. Beynon	5,077	3,301	8,400	405·0	52·2	27·6	1,900
Schuylkill	R. Anderson	5,176	3,344	8,400	411·8	52·3	27·6	2,000

SAILING SHIPS.

These carry oil in cases, and are generally employed in the Far Eastern Trade.

Vessel.	Captain.	Gross.	Nett.	Dead-weight.	Length.	Breadth.	Depth.
Brilliant	C. Morrison	3,765	3,609	5,900	352·5	49·1	28·2
Daylight	H. A. Nickersen	3,756	3,599	5,900	351·5	49·1	28·2
Comet	W. J. Davis	3,014	2,890	5,000	323·0	46·1	26·0
Lawhill	J. C. B. Jarvis	2,942	2,749	4,400	317·4	45·0	25·1
Juteopolis	P. Stewart	2,842	2,652	4,300	310·0	45·0	25·1
Alcides	J. B. Cummings	2,704	2,492	4,120	312·1	43·2	24·4
Kentmere	J. C. Amberman	2,525	2,347	3,690	300·0	42·2	24·7
Lyndhurst	P. H. Parnell	2,311	2,249	3,650	295·0	42·1	24·1
King George	J. C. White	2,242	2,057	3,430	278·4	42·1	24·2
Glendoon	H. C. Robinson	1,981	1,824	3,120	266·3	40·1	23·1
Drumeltan	L. D. Vance	1,909	1,820	2,770	266·0	40·2	24·1
Johanna	C. McIvor	1,756	1,651	2,680	239·8	37·7	22·9
Calcutta (Tank Sailer)	H. H. Davies	1,694	1,578	2,600	248·0	40·2	21·9
Arrow	D. McDonnell	3,090	2,971	5,000	327·7	46·5	26·2
Eclipse	J. McBryde	3,090	2,969	5,000	326·8	46·4	26·2
Radiant	A. Smart	1,974	1,845	3,300	264·9	40·1	23·6
Alaerita	J. Thornton	1,980	1,823	3,200	265·0	40·1	23·6

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ONE company alone—the Anglo-American—imports and sells in Great Britain each year more than one hundred million gallons of illuminating oil—enough to fill eight hundred million ordinary lamps. If these lamps were placed in line, allowing 7 inches to each, there would be 106,660 miles of lamps; more than sufficient to go four times round the world!

In 1859 the total imports of American oil by Great Britain amounted to two million gallons. Now they exceed one hundred million gallons. Yet nineteen years ago the Anglo-American Company did not exist. If the reason for such a revolution in the British oil trade be sought for, it will be found in the enterprise and readiness of the company to adopt new and improved methods of handling the business in this country.

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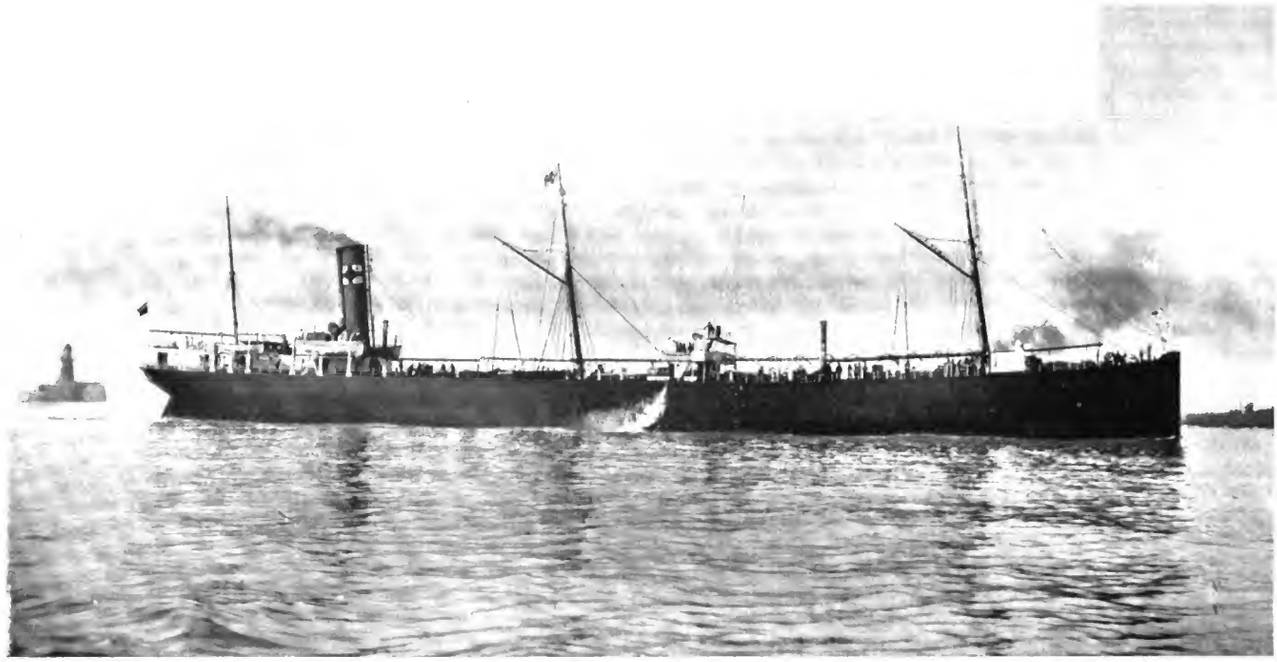
OFF THE TYNE.

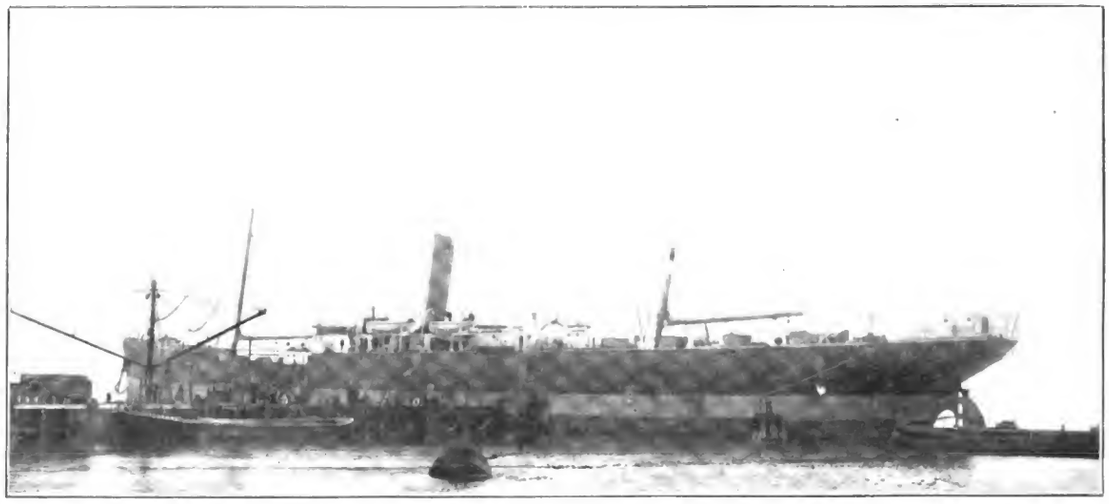


The *Elax* is one of the medium-sized steamers of the Shell Transport and Trading Company. This photo was taken as she was leaving the Tyne in April, this year, for a trial trip, after having undergone extensive repairs and overhaul, and been converted into an oil burner by Messrs. Smith's Dock Company. The work included the renewal of a considerable number of shell plates, the overhauling and renewal of the internal fittings of the accommodation, and the hydraulic testing of the whole of the oil compartments. The whole of the upper and lower decks forming the bunker space were renewed, and extra frames and web frames were fitted to the main frames on both of these decks. Included in her new liquid fuel burning equipment were the Rusden-Eeles patent burners and the Flannery-Boyd patent system of heating coils and gravitation tanks for purifying the fuel before it flows to the burners.

When the *Elax* left for her trial, practically a new steamer, she was able, with her new steam-raising equipment, to easily maintain a speed of 11 knots on a consumption of 14½ cwts. of liquid fuel per hour, this being equivalent to a consumption of only 17½ tons per day for all purposes, as against 30 tons of coal consumed for the same work on her previous voyages.

The vessel carries some 5,500 tons of cargo, and is the eighteenth steamer of this fleet fitted to burn liquid fuel.

IN THE THAMES.



The Anglo-American Oil Company's steamer *Chesapeake* (built by D. J. Dunlop & Co.) discharging oil at Purfleet.

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CHAPTER IV.

The Steamers of the Shell Transport and Trading Company.* Mr. Goulichambaroff and Sir Marcus Samuel.

FOR fifteen years the founder and head of the Shell Company, Sir Marcus Samuel, has exerted a powerful and far-reaching influence in the oil world. It was during the Suez Canal agitation (referred to in the two succeeding chapters) that his first company—Messrs. M. Samuel & Co.—came prominently to the front in the marine oil transport business. About 1892, when the Standard Oil Company had adopted the petroleum-in-bulk system, and the owners of tank steamers on the Caspian had proved it to be successful, he urged the importance of exporting Russian oil on a large scale to the markets of the Far East. The transport of Caucasian oil in cases was a huge business, but as a system it was out of date and expensive, and Sir Marcus, with his vast experience as a Yokohama merchant, saw that a cheap product like Russian kerosene could only meet the high charges of transport and the cost of getting it across the Indian and Pacific Oceans when handled in bulk. Sir Marcus considered that the engineering difficulties standing in the way of sending a tank steamer from Batoum to the Far East *viâ* Suez were not insurmountable, and just how enthusiastically and ably he put his ideas into practice forms a story which has been too frequently told by me elsewhere to be repeated in this work.

Seven years after the start (and just about seven years ago), Sir Marcus said—"This company (the Shell Company had just been formed) depends more largely upon its trade as a carrier than as an oil merchant for its earning power; this will be the more readily understood when I say that we transport some 350,000 tons of merchandise yearly, and that a rise or fall of 2*s.* 6*d.* per ton in freight means a difference in revenue of £45,000 per annum."

Sir Fortescue Flannery, in 1899, the year before the *Bulysses, Cardium* and *Strombus* were launched, declared that no cargo vessels, and probably no mail or passengers steamers, were more thoroughly, carefully and systematically kept than the Shell liners.

At that time the largest Shell steamer was the *Telena* (4,778 tons), but she carried less than half the cargo of the *Goldmouth*, the latest addition to the fleet.

The history of the concern managed by Messrs. M. Samuel & Co. for a period of fifteen years has been placed before the public in a number of different ways, and in every account it has been shown that the enterprising and extensive participation of Sir Marcus Samuel in the petroleum transport business has been an immense factor in the growth and prosperity of the illuminating oil and liquid fuel trades of the world.

There is no greater authority on petroleum production and transport subjects than Mr. S. Goulichambaroff. Thirty years ago he started elaborate official investigations in the Caucasian oil fields, and, since then, has frequently represented the Russian Government in the chief oil fields of the world. On his return from the oil fields of Texas he discussed the position of the Shell Transport and Trading Company in the markets of the world, and the following summary of his opinions will give the reader an idea of the position of the company in the year of its greatest prosperity :—

"The founder of this company, Sir Marcus Samuel, is an extremely energetic and enterprising man. For many years he has carried on an extensive trade with the Far East, and his influence is felt over an extensive territory washed by the waters of the Indian and Pacific Oceans. He is at the head of a great trading combine. Eastern goods he obtains from Eastern merchants, who, in their turn, are supplied with European (particularly English) products. The exchange of goods, in view of the great competition in these important districts, could not at the start reach a position of very great importance; but the business of Sir Marcus Samuel began to grow quickly after the opening of the Baku-Batoum Railway. Sir Marcus Samuel, foreseeing a new way of extending his undertakings, came to an agreement

* Renamed (in July this year) the Anglo-Saxon Petroleum Company.

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with Rothschild to supply him with kerosene. At that time the Far East was supplied with illuminating oil by the Americans. This market seemed already occupied. Sir Marcus did not hesitate; he decided to enter upon a struggle with American enterprise, and began to export Russian kerosene to places where there was no American competition.

"The first attempts in the export of oil in barrels or cases from Batoum showed the profitable character of the enterprise; they also showed him that the best way to distribute Russian oil at the ports of the Indian and Pacific Oceans would be to transport it in bulk. The bulk oil transport in the Caspian Sea gave favourable results, and Messrs. M. Samuel & Co. built the first tanker to run between Batoum and the Far East. With the object of opening up this trade he entered into an agreement with the Suez Canal Company for the passage of inflammable cargoes, and constructed oil stations at several of the most important points. Russian oil was shipped there in bulk, barrelled, and put into tins, for the most part old and chiefly American. This idea turned out to be a good one, and he began to order new tankers to extend the sale of Russian kerosene in the Far East. Thus Messrs. Samuel & Co. were the pioneers of this new oil transport route.* Ten years afterwards Russian oil was sent to the Far East by Mantascheff and Rothschild, but neither the one nor the other possessed the commercial experience of Sir Marcus Samuel, who relied greatly on his knowledge of the local merchants. The attempts made by the other Russian producers were not successful; in fact, they merely caused a disastrous competition amongst the vendors of Russian oil. In view of the rapidly increasing business in kerosene, Messrs. Samuel & Co. found it expedient to form a limited company. This was floated in 1897, with a capital of £1,800,000 in £100 shares. After three years the organisation of the company was re-arranged, and the capital was increased to £2,000,000, the shares being reduced to £1.

"A considerable and valuable experience in the Russian kerosene business showed Sir Marcus Samuel that it was difficult to guarantee the regular arrival of cargoes at any particular port. He felt that a successful business largely depended on this difficulty being overcome. In order to keep his tankers constantly employed he began to use them not only in the Far East, but also in the West—in England, Italy, France and other countries. Besides this, Sir Marcus entered into negotiations with certain Dutch oil companies for the transport of their produce. The kerosene of the Dutch Indies, in order to satisfy local demands, was sent to Chinese India, China and Japan, while solar and gas oils and benzine, not being in demand in those places, were sent to Europe, more particularly to England, where they entered into competition with Russian and American oils. In order to be still more independent in his illuminating oil business, Sir Marcus acquired large oil-bearing districts in the Island of Borneo, where he commenced boring on a large scale. He erected storage accommodation and made arrangements for the refining and delivery of oil. At the start results did not quite justify his early hopes, and, as far as I have been able to collect information on this subject, the enterprise in Borneo did not meet with that success which he expected to secure. It appeared to be conceived and worked out without a full knowledge of the actual wants of the trade. At any rate, the entire production of oil in Borneo, although still small, is distilled in the Shell Company's refineries.* The erection of the storage accommodation for oil and the building of the pipe-lines, reservoirs, refineries, and tankers for the coast trade cost the Shell Company a great deal of money. To cover this the capital of the company was increased by the issue of new shares to the amount of £1,000,000.

"A rich oil field was opened up in Texas. This produced oil which was cheaper than the products of Pennsylvania and the Caucasus, and also cheaper than those of Dutch India and Borneo. With a fleet of tank steamers he discovered this to be an opportune time for the larger distribution of oil in the markets of the world. With this object in view, he entered into an agreement with the largest Texas enterprise, the Guffey Petroleum Company, to export their crude oil and its products to Europe. The Shell Company, with its agreements with the American and Indo-Dutch companies, is a mighty power in the transport and production of oil. In Dutch India and in Texas it possesses immense interests connected with oil-bearing lands, and has the necessary equipment for producing and refining oil at a low cost; while in the chief markets of the Far East and in Great Britain it has all the necessary facilities for the distribution of oil products. Sir Marcus Samuel, while he has been at the head of the Shell Company, has always taken a wide view of

* Query.

* These refineries are now worked by the Royal Dutch and Shell Companies combined.

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business; he has constantly thought, not only of the trade in illuminating oils, but of many other important branches of the business, and, looking into the future, he has foreseen the growth of extensive markets for new products—gasoline, for instance, and particularly liquid fuel. Respecting gasoline, it should not be forgotten that he took the initiative in the carriage of this product in his tank vessels. He has also shown that ordinary cargoes can be safely carried in his vessels. It has likewise been proved that liquid cargoes can be carried more economically than ordinary cargoes."

The pioneer tanker was the *Murex*, built in 1892 at West Hartlepool. She has made many records; these include the carriage of the first oil cargo through the Suez. Capt. Coundon had command on her first voyage. The *Conch** was also built at West Hartlepool in the same year, the *Bullmouth* being launched at the same place a year later, when the *Trocas* (4,129 tons, and the largest of her class) was launched at Sunderland. After her came the *Elax*, *Clam* and *Volute*, all built at West Hartlepool in 1893. The *Nerite* was launched on the Tyne in 1895, and her loss in the Suez Canal is referred to in the chapter devoted to tank steamer catastrophes. During the first three years the company converted a number of cargo vessels into tank steamers, the *Euplectela* (since sold) being one of the most successful.

It was not until 1899, when Borneo started to attract attention as a liquid fuel producing island, that the company decided to order leviathans of the type of the *Cardium* and *Bulysses*, and three years later, record oil-carriers like the *Pinna* (sold), *Silverlip* (lost) and *Goldmouth*. From the start it was always recognised that wherever and whenever an improvement was possible in transport equipment and facilities ashore or in the steamers the money of the shareholders and the enterprise of the directors were quickly employed to take advantage of the new ideas, particularly when they promised to develop business in connection with the transport of oil in bulk and the working of oil properties in Borneo.

* This liner was wrecked in 1903 on the Akurala Reef, while on a voyage from Colombo to Madras. She had only been a short time on the passage, when she encountered heavy weather and drove ashore on a treacherous part of the coast. Within a quarter of an hour of striking her bows were under water, and two hours after she broke in two. Owing to the tremendous surf breaking on the shore, the boats were unable to land, but the natives came to the rescue and succeeded in landing the shipwrecked crew, eleven Europeans and thirty-four Lascars.

It is quite impossible to give particulars of the numerous experiments carried out on Shell steamers. I have, however, attempted to summarise the accounts of some of their most important performances as oil fuel burners and dual cargo carriers; for it is largely, if not chiefly, owing to the experiments of this company that shipowners and others have come to see that the modern tank steamer can load, carry and discharge delicate and even perishable cargoes with the same facility and economy as ordinary cargo vessels.

* * * * *

The *Trocas* carries 6,000 tons when fully loaded with oil. She is fitted with three large single-ended boilers, each with three furnaces, and one multitubular donkey-boiler with two furnaces, all specially equipped with liquid fuel apparatus in 1901, eight years after she was launched. An obstacle in the way of fitting old steamers with liquid fuel burning arrangements is the difficulty of constructing suitable spaces to carry the oil. Ordinary coal bunkers are not suitable, as the rivetting and plating are not oil tight. With the "Flannery-Boyd" system employed on the *Trocas*, the oil is carried in the ballast tank spaces—namely, fore and after peaks, double bottom ballast tanks under the engines and boilers, forward ballast tanks adjacent to the fore-peak, and forward and after cofferdams. The great difficulty in carrying liquid fuel in these spaces is that owing to imperfect drainage a certain quantity of water is always left in the ballast tanks. This water becomes mixed with the oil, which, on passing to the burners, causes explosions, and generally puts out the flame. The "Flannery-Boyd" system claims to get rid of the water in the liquid fuel. Two liquid fuel settling tanks of large capacity are placed in the 'tween decks amidships, immediately adjacent to the boiler room bulkhead. These are fitted with all the necessary heating coils, drainage arrangements, thermometers, and other fittings to enable the liquid fuel to be heated to a sufficient temperature to allow of the water freely separating. The water then settles to the bottom of the tanks and drains off. The settling tanks can be filled either direct from the deck or the forward liquid fuel carrying spaces by means of a pump placed at the forward end of the vessel, or from the after ballast tanks and cofferdam by means of two special pumps placed in the stokehold. The liquid fuel gravitates from the settling tanks through suitable filtering arrangements direct to the burners, and is, by means of the burners, injected into the

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furnace with a spray of steam. Each furnace is fitted with two burners, and the furnace arrangements are such that the complete coal-burning gear remains intact when burning liquid fuel; so that if the vessel is burning liquid fuel, and it is found necessary to resort to coal it is only a matter of raking out a few fire-bricks, disconnecting the burners, and lighting a coal fire. This can be done without stopping the vessel, and the change in a large vessel can be made in less than an hour. Thus coal or oil can be burned at will, and an owner has the option, in whatever part of the world the steamer may be, of taking either coal or liquid fuel on board, whichever he may find to be the most economical, provided the latter is obtainable.

Although the system has been adopted on the *Trocas* and other old steamers of the company, it is also applicable to new vessels in which the oil is carried in specially constructed bunkers or in the ballast tanks, as it is frequently found that liquid fuel contains a quantity of water, which must be eliminated before it can be satisfactorily burned in the furnaces.

The Wallsend Slipway and Engineering Company, Ltd., are the licensees and makers of the Flannery-Boyd system and the Rushden and Elles' burners.

One of the great oil-carriers of 1899 was the *Strombus*, built by Messrs. Armstrong, Whitworth & Co., at Walker. Besides carrying a larger cargo than any tank steamer then afloat she embodied the latest developments of a combined oil and cargo steamer. She is arranged on Swan's patent principle, by which accommodation is provided for the expansion and contraction of the cargo under varying conditions of temperature, without in any way limiting the capacity of the holds for the reception of ordinary cargoes.

In many of the Shell liners the system of oil burning is that of Messrs. Armstrong, Whitworth & Co. and Mr. E. L. Orde. The liquid fuel is introduced into the furnace in the form of vapour. An important characteristic of hydrocarbon oils is that, in the presence of superheated steam, they can be completely distilled without cracking, and the explanation of this fact has been stated to be that, in the presence of superheated steam, the boiling point—or, more correctly, the mean boiling point—of the oil is lowered. This distillation, however, does not apparently take place with any other medium but steam. To ensure distillation, it is necessary that the temperature of the oil shall be raised to as near boiling point as possible before it is admitted into the presence of the steam, and it is in this part of the process that the danger of cracking appears.

In the apparatus fitted on these vessels complete vaporisation is secured, a fact which has been demonstrated times out of number in the presence of experts connected with every branch of the shipping and engineering industries. The vapour is completely oxidised by the amount of air chemically necessary, and it is claimed by the makers that a larger quantity of oil is treated in the same furnace space than in any other systems. While the specific amount of air actually required for complete combustion is 14·4 lb. per pound of oil, the amount recorded in connection with the boilers of the *Bulysses* is 14·7 lb. At the same time the temperature of the waste gases never exceeds 530° F.; the boilers being of the ordinary marine type, 16 ft. 6 in. in diameter, by 11 ft. 9 in. long, with four corrugated furnaces. The boiler pressure is about 180 lbs.

The hydrocarbon vapour is exceedingly unstable, and appears to depend for its existence upon its temperature. The outer service of the jet is at once condensed, and forms an oily deposit of very much lighter colour than the fuel oil itself. But when burned in a boiler furnace over a layer of broken fire-brick, it gives a flame of dazzling whiteness, which becomes almost transparent as it approaches the bridge. The appearance of the flame at a distance of a few inches from the nozzle of the burner suggests that, at that point, the hydrocarbons are burning in the form of acetylene. At the higher temperature which prevails in the centre of the furnace, the rest of the vapour is probably burnt as carbon monoxide and hydrogen.

The *Bulysses*, referred to in the preceding paragraph, was also built by Messrs. Armstrong, Whitworth & Co. When she was leaving the Tyne for her trial trip on August 21st, 1900, she struck and sank the Tyne collier *Greenwood*. The *Bulysses*, like her sister ship, the *Cardium*, carries oil in bulk, with special cleansing and loading and discharging facilities for rapid conversion into a grain or general cargo carrier. She burns oil fuel. All the vessels of her class have been constructed to carry oil cargoes East and general cargo home, and conform to the Suez Canal regulations.

The *Pinna*,* a larger vessel than the *Bulysses* when she was launched by Messrs. Armstrong, Whitworth & Co., in February, 1901, made a record for size, and, in addition, was intended to

* Sold last year to Messrs. Lane & Macandrew.

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inaugurate a new trade, her oil bunkers and oil-burning apparatus being designed for the non-stop run from the Far East to this country. The expansion of the liquid cargoes is arranged on Suran's patent principle, whereby ample range for expansion is provided for under the most extreme variations of temperature. For the rapid loading and discharging of cargoes every provision is made. She has a powerful steam windlass, warping capstan, steam steering gear, and is fitted throughout with electric light. The engines, supplied by the North-Eastern Marine Engineering Company, Wallsend, are of the triple expansion type, with cylinders 28 in. by 46 in. by 77 in., with a common stroke of 48 in. Steam of 180 lb. pressure is supplied by three large single-ended boilers.

There have been two Shell liners named *Pectan*. The first was sunk by a French steamer off Algiers. Before she went to the bottom she performed a national service. The British battleship *Victorious* was ashore near Suez, when the *Pectan* towed her off after twenty hours' persistent work, and earned Sir Marcus Samuel his knighthood.

When the second *Pectan* was delivered by Messrs. Gray & Co. and the Central Marine Engine Works, Hartlepool, in 1902, she was the largest bulk oil-carrying steamer afloat. She is running in the oil trade to-day, a most successful vessel in every way. She takes Lloyd's highest class, and has two complete decks. The engines are aft, and underneath these the vessel has a double bottom, while the forward and after peaks and a deep tank in the fore-hold are constructed for water ballast for trimming purposes. Forward of the boiler room, thirteen transverse bulkheads are fitted with a very strong middle line bulkhead, from the keel to the main deck. The bunker spaces carry either coal or oil fuel, and there are eighteen separate oil cargo compartments, in addition to cofferdams and other spaces. The tanks carry the exact quantity required for winter, summer, or Indian summer loading. The scantlings are heavy, the rivets closely spaced, and the plates of large size to reduce the number of joints. Expansion trunks are carried up from each oil tank to allow the oil to rise and fall with varying temperatures, and hatchways of ample size are fitted to each compartment to take in ordinary cargoes. Oil pipes, 10 in. diameter, fitted with controlling valves, are carried throughout the oil compartments, and shore connections are fitted to each side amidships and over the stern. Two powerful pumps amidships are capable of discharging 300 tons of oil per hour. The same pumps and pipes are used to fill the oil tanks with water for cleansing them before ordinary cargoes are carried, or when needed as ballast. A powerful fan is capable of exhausting air from any compartment in ten minutes, and ensures thorough ventilation when general cargoes are carried. A complete installation of electric light is fitted in all compartments, and includes a 20 in. Suez Canal light projector. To avoid fire risks the quarters for the crew are heated by steam only.

It was in connection with the running of the *Pectan* that Sir Marcus Samuel said, in 1902, that in ten years his company had built and purchased thirty-eight steamers, with a dead-weight capacity of 152,000 tons, and stood fourth in order of all the British lines going through the Suez Canal. The company had spent in this brief time no less a sum than £4,600,000.

Although there is a distinct similarity between the latest of the Shell liners, each one has been an improvement on her predecessors, and embodied some idea which has made her in her year the largest and best of her kind. Just as it is not possible within the limits of a single chapter to enumerate the improvements which have been carried out, so I cannot for the same reason (want of space) undertake to give particulars of the numerous interesting records made by Shell steamers. There are, however, a few which may be mentioned.

There is the one of the *Clam*, which, running in the East for two years, made an itinerary of 85,000 miles on oil fuel. The calculation was made that her engines worked 32,000,000 revolutions, and the fuel burning apparatus, when examined by experts on the arrival of the steamer in the Thames, showed it to be just as perfect as it was on the day that she left this country for the East.

One of the earliest records by Shell steamers was made by the *Cowrie* in 1900. She was the first oil-burning vessel to bring a cargo of oil from Balek Pappen to the Thames. The cargo was discharged with her own oil-fired donkey engine.

Just before the *Cardium* went to load the first cargo of Texas oil for England she carried a record cargo of 8,200 tons of sugar from Java to Philadelphia. It has been found in actual practice on the *Cardium*, and, indeed, on all the largest vessels of the Shell line, that they can load cargoes of cotton, rice and sugar in competition with ordinary cargo steamers. The system of cleansing and purifying the tanks works to

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perfection, and the opinion is no longer held that an oil-carrying vessel is either unsuitable or unsafe in a first-class general trade. A few years ago the *Goldmouth* and other Shell steamers ran under charter to the Far East for one of the large passenger steamship companies.

While tank steamers go to the Far East *viâ* the Canal, some of the Shell liners have been specially equipped in the matter of bunker space to make non-stop runs by way of the Cape. The *Bulysses*, *Goldmouth* and other oil-fired tank steamers have made non-stop runs from Singapore to Europe, but there is still a difference of opinion as to whether, comparing the cost of additional fuel and other obvious expenses with the saving of canal dues, these long runs have any real financial advantage over the shorter ones by way of Suez.

The *Murex* arrived in the Thames in February, 1902, after she had made the voyage from Singapore, *viâ* the Cape, in less than fifty days, oil-fired throughout the run. A large party of shipbuilding and engineering experts went to the London and Thames Haven Wharf to witness experiments in the burning of liquid fuel under ordinary working conditions. The party included Sir Marcus Samuel, Mr. Goulichambaroff,* Sir Fortescue Flannery, Sir John Colomb, M.P., the well-known authority on naval shipbuilding and tactics ; Commander A. R. Hulbert, of the Naval Intelligence Department ; Lieutenant Sladen, of the Metropolitan Fire Brigade; representatives of the Russian and Japanese Governments, and many others.

The vessel's log books (open for inspection) showed that the average expenditure of liquid fuel had been less than 16 tons per day, and that throughout the voyage a speed of nearly 10 knots had been maintained. The party paid a visit to the stokehold, where special attention was devoted to the clean and undamaged state of the furnaces, which had been in use for two years. It was explained by the engineers that the vessel had been brought from Singapore with three firemen, against some twenty-four necessary in the case of a coal-fired steamer of similar tonnage.

One of the earliest non-stop records was made by the *Cardium* in 1905, when she steamed from Singapore to Dover, *viâ* the Cape, in fifty days on an oil consumption of 32 tons per day. She steamed at an average speed of 9¾ knots and carried 8,400 tons of oil. Later in the same year she went from London to Penang, *viâ* Suez. She was thirty-nine days steaming on a consumption of 29 tons per day, averaging 9¾ knots, and carrying 8,400 tons. This vessel on a similar voyage steamed at 8·1 knots on a daily consumption of 49 tons of coal.

The ill-fated *Silverlip* steamed from Singapore to Dover, *viâ* the Cape, in forty-eight days on a consumption of 36 tons per day. Her average speed was 10½ knots, her i.h.-p. 2,300, and she carried a total dead-weight of 10,300 tons. During the entire run the main engines and the liquid fuel apparatus worked without a stop or hitch of any kind.

When the *Goldmouth*, sister ship to the *Silverlip*, made her non-stop runs from Singapore to Rotterdam, she took about fifty-two days.

Years ago this company earned the reputation of being an exceedingly lucky one, and few ship-owning firms of similar magnitude had sustained so few losses ; indeed, the freedom of the fleet from trouble was often mentioned in shipping circles, and this was all the more remarkable seeing that many of the steamers were constantly employed in hot countries in what is erroneously considered to be a most dangerous trade.

Recent losses, the *Nerite* and the *Silverlip*, the first in the Canal and the other just after she had reached the Bay of Biscay, homeward bound, have somewhat damaged the company's record for freedom from serious accidents.

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Whatever may be the future of this company, now amalgamated with the Royal Dutch, the name of Sir Marcus Samuel must always remain famous in the world of oil.

Sir Marcus is the second son of the late Mr. Marcus Samuel, a gentleman who was closely associated with the heads of the Jewish community, and actively interested in benevolent work for many years. He spent his boyhood days between Islington and Moorgate Street, I think, in Finsbury Square, where, it is stated, his old home is used by the chief Rabbi to-day. He received his education at a school at Edmonton, and afterwards at Brussels. Later, he paid visits to Ceylon, the Straits Settlements, Siam, the Philippines, China and Japan. To the knowledge thus gained may be attributed, in a great

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* Mr. Goulichambaroff said to me on this occasion—"Russia, as you know, is in no way behind this or any other country both with regard to the oil-burning apparatus and the carriage of oil in bulk. I must be candid and tell you that I do not see anything strikingly new on board the *Murex*, excepting that she has carried benzine in bulk."

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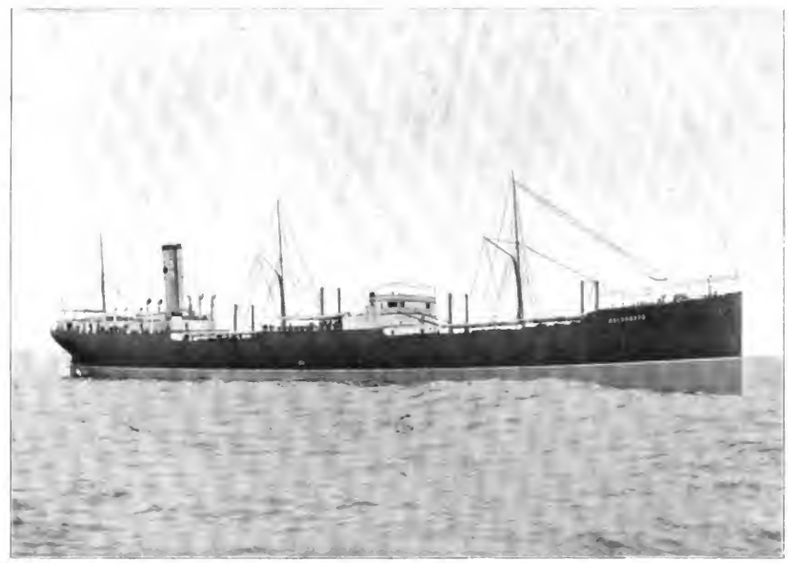
IN this picture are Sir Marcus Samuel and some of the leading authorities on tank steamer building and fuel subjects. From the right, Col. Swan, whose name is associated with the earliest developments of the bulk oil system in this country; behind, Mr. E. L. Orde, the well-known liquid fuel authority and inventor of the "Orde" system of burning employed on many steamers built by Messrs. Armstrong, Whitworth & Co., Ltd.; then to the left, Sir Fortescue Flannery, naval architect and liquid fuel burning authority, whose firm (Messrs. Flannery, Baggallay and Johnson) has superintended the building of most of the Shell steamers; fourth from the left, Sir Marcus; and next to him Sir Andrew Noble, one of the foremost shipbuilders in the North of England. With the bouquet: Lady Samuel.



THE *Goldmouth* is the largest of the Shell steamers. Besides the ordinary oil hatches, she has hatches for working general cargo, and these are so arranged with derrick posts and derricks, that cargo is discharged as quickly as in an ordinary cargo steamer. The bunkers are arranged for carrying oil fuel as well as coal, and the furnaces burn oil on the Flannery-Boyd system.

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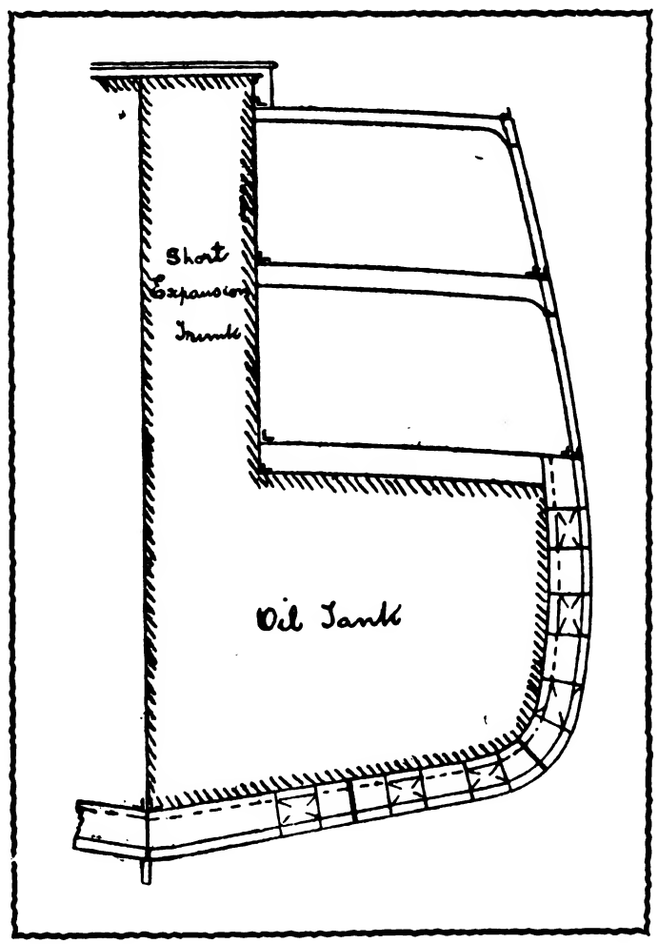
measure, the marked development that the business of the firms of M. Samuel & Co. and Samuel, Samuel & Co., of Japan, have exhibited in this country as well as in the Far East.

When Sir Marcus became the ruling spirit in these concerns, new departures were entered upon. They were responsible for the launching in London of the first Japanese Gold Sterling Loan of £4,500,000, and were largely concerned in the placing on the market of Japanese Municipal Loans, and in the development of the coal trade in Japan.

Early business relations with high Japanese authorities, and his own personal knowledge of the trade routine and customs of the country, assisted him materially in opening up those channels through which the products of the oil fields of Borneo flowed into Oriental centres of civilisation. Sir Marcus and his colleagues owe much of their early success to Japanese sympathy and enterprise. He, however, established his companies and made his own personal fortune by the untiring industry he displayed in backing up his proclamations of faith in the future of the oil industry, and particularly in the maritime and liquid fuel branches of it.

Sir Marcus is the only oil man who has been Lord Mayor of London. His year of office was 1902, and his election took place just ten years after he started to run his first oil-carrying steamer.



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THE observation that the man who makes two blades of grass grow where only one grew before is a benefactor to his race, finds an analogy in the assertion that he who practically adds to the span of man's life by increasing the number of hours wherein he can labour or enjoy himself is also a benefactor. . . . The welcome, cheerful, steady flame of petroleum brightens the cabin of the Western emigrant on his trail through the trackless forest, and lights up the hut of the Colorado miner. It cheers equally the home of the thrifty farmer, and the rough quarters of the humblest labourer. Its bright rays lend their kindly aid to the thousand homely cares which give zest and happiness to the family circle. The sum of human knowledge is increased, and the aggregate of wealth added to, by the useful employment of hours snatched from darkness and sleep; man's life has been extended and his opportunities for usefulness increased. The circumstances which have led up to the present general use of the hydrocarbon light are varied. The torch or flambeau of the Russian peasant of the Caucasus, or the rude smoky lamp of the Rangoon labourer, afforded a small margin to the inventor to hope for improvement.

BENJAMIN J. CREW (1886).

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CHAPTER V.

The Transport of Bulk Petroleum through the Suez Canal. Attitude of Lord Salisbury.

THE year 1891 was an eventful one in oil. A crisis was brought about by an attempt to get bulk oil-carrying steamers Suez Canal privileges. Reports were circulated that the application had been made on behalf of an English syndicate, and those who were responsible for the initiation of what proved to be a most determined, bitter, and excellently engineered agitation declared "that an undertaking had been obtained from the Canal directors to allow the passage of tank steamers under certain conditions."

Now, when tank steamers trade with perfect safety and without opposition on the smallest of confined waters, inland lakes, and the smallest and most crowded of shipping rivers, it is difficult to imagine the fierce feeling of hostility displayed by the shipowning classes of these islands in 1891, when this controversy was engaging the attention of the Suez Canal Company, the British Foreign Office, and numerous petroleum concerns in Russia, America, and this country. The struggle was a great one, and numerous gigantic trading interests, the Welsh tinplate trade amongst others, were concerned.

Those who were petitioning the Canal Company (the Samuel group, with its immense Yokohama experience and general trading connections) were not, as was generally supposed, the pioneers of the idea of canal navigation by bulk oil-carrying vessels. The Standard and the Anglo-American Oil Companies had organised considerable oil shipping interests, and the American office had, some years before, applied for permission to send the petroleum products of the Pennsylvania and Ohio oil fields and their refineries, huge concerns even in that day, through the canal. Mr. Rockefeller, then the active head of the Standard, wanted to get American oil to the Far East by the shortest route; but, on the ground that serious consequences must follow an accident to a tank steamer in the canal, his application was refused.

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The idea of sending both Russian and American oil to the Far East *viâ* the canal was considered a safe business by numerous practical petroleum men, and when the British group took the question up the controversy which ensued greatly interested influential and wealthy oil men at Baku and Batoum. It was also followed with an equally keen interest by a St. Petersburg shipping concern, the Black Sea Steam Navigation and Trading Company, founded by the late Grand Duke Constantine Nicolaivitch, with the Russian Imperial family as shareholders. The heads of this company watched with considerable anxiety the result of the application of the British syndicate. Subsidised by the Russian Government—so largely, it was pointed out, that goods could be carried at merely nominal rates of freight, while dues paid to the Suez Canal were refunded by the Government—their tank steamers were in a position to compete with British vessels in the event of their being granted permission to go through the canal. Messrs. Bowring & Co., who took a prominent part in the controversy, published some information about this company.

They owned installations for the storage and distribution of petroleum in Odessa, Nicolaieff, Sebastopol and Kertch, as well as in the Danubian ports, the latter business being worked in conjunction with the Russian-Danubian Steam Navigation Company. They were, therefore, perfectly familiar with all the operations connected with the carriage and distribution of petroleum in bulk. The full influence of the company was brought to bear on the French directors of the Suez Canal Company through the Russian Embassy in Paris. They were in a position, not only to monopolise the transport of petroleum in the Eastern markets, but to extinguish the budding trade in those markets by erecting their own installations.

Not only was it urged by the opponents of the tank steamer that Russian vessels would ultimately

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secure a monopoly of the trade, but that, being officered by quasi-Russian naval officers and manned by Russian naval seamen, these vessels would constitute a serious menace to British shipping. It would be easily within their power to block the navigation of the canal at any given time and destroy all the shipping in it; indeed, Lord Salisbury was asked to see the importance of opposing the scheme not merely in the interests of individuals, or even of the general shipping community, but in the general interests of the British nation.

At that time we were continually in disagreement with Russia, and, naturally, this argument had considerable influence in shipowning and political circles; but time has proved that Russia has not even attempted to secure a monopoly, and to-day we find that the oil-carrying vessels leaving Black Sea ports are practically all British-owned. In this way did the application of the British syndicate become one of world-wide interest and lead to the consideration of the question of the transport of oil in bulk through the Suez Canal by Lord Salisbury, the Right Hon. Mr. James Lowther, and other politicians, who admittedly favoured the proposed innovation on properly regulated and defined lines.

It was on July 2nd, 1891, that Messrs. C. T. Bowring & Co. wrote Lloyd's a letter which passed in successive intervals of a week from Lloyd's to the Board of Trade, from the Board of Trade to the Foreign Office (Lord Salisbury), and from the Foreign Office to the Directors of the Suez Canal.

"Clients of ours," wrote Messrs. Bowring & Co., "inform us that they hear with apprehension it is contemplated that tank steamers carrying petroleum in bulk will be sent through the canal, and they desire to bring before the attention of the underwriters at Lloyd's the great risk which, in their opinion, there would be to their ships and merchandise in the canal, in the event of a collision or similar disaster occurring to these boats, which, on the assumption that they are constructed to carry the oil next the outside plates in large chambers, would, in the event of a hole being made in their side, discharge the oil into the canal."

The first communication giving details in a lengthy and important controversy was written by Messrs. Russell & Arnholz to Lord Salisbury on October 30th, 1891, enquiring whether, in the contemplated rule which the Suez Canal Company were about to make to permit the passage of petroleum tank steamers through the canal, a clause would be inserted exonerating the vessels from liability in case of accident through collision, or otherwise, on payment of tonnage dues.

Lord Salisbury, through Mr. James Lowther, answered in a six-line affirmative. Messrs. Russell & Arnholz's letter was forwarded by Mr. Lowther to the Suez Canal Company, and the British directors, Messrs. J. Stokes, C. Rivers Wilson, and H. Austin Lee, replied (November 6th, 1891) :—"It is true that the Suez Canal Company do not, as a rule, inquire into the contents of a ship's cargo, but, considering the dangerous character of petroleum if it becomes ignited after its escape from a ship's hold, and the serious conflagrations that have occurred from burning floating petroleum, the exception in this case is fully justified. . . . The discussion was adjourned for a month to get further information."

Messrs. Russell & Arnholz, addressing Lord Salisbury four days later, finding that the matter presented greater features of peril than were believed to exist when they despatched their last letter, called attention to the following additional facts bearing on the question of responsibility :—

"(1) It would appear that the tank ships ordered for this traffic are to comprise tanks twice as large as those considered safe in northern waters. This, as a matter of fact, makes it incumbent upon some one to assume the responsibility in this respect, as the state of our marine insurance laws with their collision clause in policies leaves so great a margin of damage unsettled, that with the Suez Canal rule the whole matter should be defined. (2) The matter rumoured in the papers that the nominees of Her Majesty's Government on the Board of the canal favoured this bulk transit, leads to the conclusion that they must have accepted all its consequences, one of which is the question of these enormous tanks in the bulk petroleum ships. How far the support of the Government directors to the passage of petroleum in bulk, which is a disturbance of the regular and safe case oil trade, is a violation of the 12th section of the instrument guaranteeing the neutrality of the canal, and also precluding any one of the Signatory Powers from seeking commercial advantages on the canal, will, no doubt, form a further subject of inquiry in proper quarters."

Lord Salisbury, having received the observations of the British directors of the Suez Canal Company, explained to Messrs. Russell & Arnholz that the payment of dues did not exonerate any vessels from liability incurred through collision or other accident, and the company could not, therefore, see any ground

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for making provision in favour of petroleum tank ships. "The company," he said, "do not, as a rule, inquire into the contents of a ship's cargo, but, considering the dangerous character of petroleum if it becomes ignited after it escapes from a ship's hold, and the serious conflagrations that have occurred from burning floating petroleum, the exception in the case of petroleum tank ships appears to them to be fully justified."

Messrs. Russell & Arnholz "concluded that the responsibility, from the point of view of the Government, rested exclusively with the owner of the petroleum tank steamer, and this although by the proposed rule he is compelled to pay tolls and dues in excess of the ships of ordinary commerce." Continuing they said :—

"The inference is that the passage of petroleum tank ships is a matter of privilege purchased by submitting to exceptional tolls and regulations. We, therefore, beg to state that we do not consider those upon whom your directors fix the responsibility as furnishing an adequate security for the exceptional risks they are made to run from cargoes of liquid petroleum in the exceptional climate and on the exceptional waters of the canal. In this conclusion we think we are more than justified by the observations of your directors in pointing out the dangerous character of petroleum if it becomes ignited after it escapes from a ship's hold. In view of their admission of this danger we have no doubt that the term of very contract on the part of a carrier implied by law that his vessel is tight, staunch, and strong will be made absolute, not as in the case of cargoes of solids, but as having regard to liquid petroleum, so that absolutely no leakage whatever will take place on the canal, and, the better to secure this, that the Canal Company shall be held strictly responsible for the execution of this clause. This conclusion seems all the more warranted from the fact that liquid petroleum, in the eyes of the British directors, justifies the Canal Company in, for the first time, drawing a distinction between cargoes and, we may add, making storage tender service compulsory, limiting the draught of water in particular ships built previously to 1889, and otherwise making exceptional the conditions of navigation. We are happy to note that the draft regulations on the point of exceptional cargo are reserved for further discussion, but respectfully submit that the British directors should have first considered the difficulties before they pledged themselves and Her Majesty's Government to support a principle which, by their own observations to your lordship, they look upon as dangerous from the burning of floating petroleum when ignited. We may at least hope that the regulations will make impossible any danger from this or any other cause which may arise to imperil the lives and properties of those using the Suez Canal. We still maintain the conclusions of the letters we have addressed to your lordship on this subject—that the responsibilities and the persons to whom they attach shall be accurately described and defined, and in view of the fact that the payment of dues does not fix the responsibility on the canal, by the observations of the British directors, we maintain that the gravity of the circumstance compels us to condemn the proposed rules *in toto*, and humbly to submit that the question should be referred to a commission of the maritime Powers."

Lord Salisbury asked Messrs. Russell & Arnholz to inform him for whom they were acting in the matter. To this interrogation they replied :—

"With reference to the latter part of the same, in view of the opposing commercial interests engaged, and the fact that the true promoters of bulk transit have not yet declared themselves, we respectfully submit that, without pleading the privilege of our profession, it would be imprudent on our part to permit our clients to disclose their names; but your lordship may rest assured that, at the proper time, when the names of the true instigators of this dangerous departure shall have been made public, we shall consider it our dutiful pleasure to communicate to you the names of our clients and their full purposes in endeavouring to avert what is honestly deemed to be a danger to general commerce."

Communications of a controversial character were then written. Messrs Russell & Arnholz, (November 20th, 1891) sent to the ambassadors of the Signatory Powers of the Suez Canal Company's charter a long criticism of the Canal Company's intention to formulate a rule authorising and regulating the transit on the canal of steamers carrying bulk petroleum "in enormous masses, flush with the skin of the ship, in tanks of extravagantly large dimensions."

The proposed rule, they explained, authorised the passage of bulk petroleum ships, and this to the disturbance of commerce generally and the convenient and safe mode of trading in petroleum for the Eastern market in vogue over the canal. The responsibility was such, in view of the high temperature of the canal and the character of a liquid cargo

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of petroleum, the liability to leakage, apart from the danger of collision, stranding, etc., that responsible individual shipowners would not have cared to face the consequences attaching to such a mode of trade. It appeared, however, that certain influential financiers and merchants who, among other things, were vendors of petroleum, had combined as a syndicate, and prompted the Canal Company to admit in principle the passage of bulk steamers, and to shape and propound the rules which inhibited every vessel laden with bulk petroleum, built before 1889, from taking advantage of the authorisation to carry petroleum in bulk on the canal. They contended at great length that there was no justification for disturbing a well-defined system of petroleum trade by a loose method, fraught with peril and involving responsibilities which they were assured were never accepted by the canal, and could not, in view of the conflicting state of marine insurance throughout the world, be covered adequately by insurance. The exceptional character of the cargo, in view of the exceptional climate of the canal, was a matter of so much importance that neither the proposed rule, which stood condemned by the very arguments intended to defend it, nor any rule permitting the transit of bulk petroleum, should receive the character of finality until it had received the sanction of the Ottoman and the Egyptian Governments, and a Commission of the maritime Powers specially empowered to take into consideration all responsibilities attaching to this method of trading in petroleum. Under those circumstances they submitted that neither the contemplated rule, nor any rule having for effect to permit petroleum in bulk to pass on the canal, should be allowed to come into force except with the consent of the Sublime Porte, after previously coming to an understanding with the principal Powers interested.

This letter drew from the British directors of the Suez Canal Company a comprehensive and vigorous reply. This was sent from Paris to Lord Salisbury on December 1st, 1891. I give the following extracts :—

"Messrs. Russell & Arnholz have rather complicated their inquiry by assumptions not in accordance with fact, due no doubt to their being imperfectly acquainted with the matters of which they write. Their first assumption is that the contemplated regulations for the prevention of danger to the general navigation through the admission of these tank ships will impose additional tonnage dues on these vessels. This is not the fact; these vessels will pay the same tonnage dues as other vessels. They would, however, only be allowed to navigate the canal on condition of being accompanied by a storage tender, for which a daily charge would be made. Such a charge is no new thing, a similar charge for the services of a tug steamer having been recognised from the opening of the canal. The second erroneous assumption of Messrs. Russell & Arnholz is that the directors named by Her Majesty's Government on the council of the Suez Canal Company have pledged themselves and Her Majesty's Government to support a principle dangerous from the burning of floating petroleum when ignited. Messrs. Russell & Arnholz are again not very clear in their expressions. As your lordship is aware, we have received no instructions on the subject, and we have only taken part in the discussion from a general view of the rights and duties of the company. The matter was referred to us by your lordship in the shape of an inquiry from Lloyd's whether proper regulations were to be enacted. This great insurance institution did not suggest prohibition of the traffic—only the regulation of it—which we have endeavoured, in concert with our colleagues, to provide for without committing either Her Majesty's Government or ourselves to any special responsibility.

"The London Committee of the Suez Canal Council were in favour of allowing these tank steamers to pass if they were subjected to special regulations and restrictions that would, as far as possible, render their passage harmless to other ships; the London Committee holding the view, which is certainly our own, that, subject to such conditions, it was not open to the company under the terms of their concession to refuse admission to the canal to any class of commercial vessels complying with the regulations.

"The third assumption of Messrs. Russell & Arnholz is that the intervention of Her Majesty's Government, through their nominees on the Council, gives rise to the question whether the 12th section of the instrument guaranteeing the neutrality of the canal is not thereby violated, the Signatory Powers being precluded by that instrument from seeking commercial advantages on the canal. It is to be observed that the regulations under discussion are not aimed at the vessels of any particular flag. Her Majesty's Government are represented on the Canal Council as the largest shareholders of the company, but their nominees have never sought exclusive advantages for the ships of any one country, though

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more than four-fifths of the tonnage passing through the canal is that of ships under the British flag ; and we are, as a matter of fact, without any data as to how far the facilitating of the passage of these tank ships and the possible curtailment of the trade of petroleum in cases will affect one flag or another.

"Messrs. Russell & Arnholz have further assumed that this matter is a subject for reference to the Powers of Europe, and have accordingly addressed a circular to the ambassadors in London of the Signatory Powers to the Suez Canal Company's charter, on which we would merely remark that none of the Powers were parties to the charter except the Sultan of Turkey.

"So long as the Suez Canal Company complies with the stipulation in its concession, which requires that the flags of all nations shall be treated on a footing of perfect equality, no such intervention as these gentlemen invoke would appear to be justified. As there is nothing in the proposed regulations which infringes the above stipulation, the Canal Company would certainly resist any such interference with the right conferred by their concession to enact and enforce all regulations required for the navigation of the canal.

"There is a striking inconsistency in the letters of Messrs. Russell & Arnholz. They complain—(1) That the Suez Canal Company are taking a new departure in making any inquiry into the contents of the cargo of vessels passing through the canal; (2) That vessels laden with petroleum in bulk should not be allowed so to pass ; and (3) That vessels so laden should not be subjected to special tolls and exceptional regulations.

"If the company did not make the inquiry, how could they know which ships to stop or which to let pass? If, yielding to Messrs. Russell & Arnholz's first complaint, they let every vessel pass unheeded, it would surely be more dangerous to public interests than subjecting such vessels to restrictions which minimise the danger. The same remark applies to their complaint that a distinction is to be drawn between crude and refined oil. Crude petroleum is well known to be most dangerous and very easily ignited, whereas refined oil of a certain standard is comparatively safe. They complain that the exceptional climate of the Suez Canal requires a higher standard ; the standard proposed is that in force in the port of Bombay, which is certainly not less hot than the Suez Canal. Messrs. Russell & Arnholz assume that the tanks will be so constructed as to be flush with the skin of the ship, and that they will be of extravagantly large dimensions. As to the first of these complaints, we would observe that the fore and aft parts of each ship are reserved for the crew and machinery, the tanks being amidships. If a collision occurs in the canal it is most unlikely that a vessel would be struck amidships, the points of contact being either the bow or the stern, where there are no tanks.

"As to the maximum cubical contents of each tank, it has not yet been fixed, though it has been carefully discussed. Messrs. Russell & Arnholz's apprehensions on this point are, we believe, groundless. They are also in error in assuming that vessels built prior to 1889 are to be excluded from the canal. They have also raised the question of marine insurance, a point on which the company had decided to take further information before any letters had been received from these gentlemen. They decline to give your lordship any clue for the present as to the names of their clients, but an expression in their letter of November 10th, which describes the passage of petroleum in bulk as a disturbance of the regular and safe case trade, leads to the inference that they are pleading the cause of parties engaged in sending petroleum through the canal packed in cases, and whose interests they appear to think may be damaged by facilities being given for the more economical conveyance of petroleum in bulk by these tank ships. It must, however, be said for them that they plead more strongly for the tank vessels, as they challenge the right of the Canal Company to deny passage to any vessel that has paid dues. Messrs. Russell & Arnholz demand that the responsibility of any accident occurring should be fixed on certain well-defined persons. It appears to us that maritime law provides for this."

The Foreign Office then informed Messrs. Russell & Arnholz that Her Majesty's Government could not take action in the direction indicated without full information as to what British interest they represented in the matter.

In a memorandum to the Foreign Office Messrs. Russell & Arnholz discussed the statutes of the Suez Canal Company and the contemplated rule. Referring to Article XII. of the convention, they pointed out that the contracting parties agreed that none of them should endeavour to obtain, with respect to the canal, territorial or commercial advantages or privileges. The British Government were the owners

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of 179,000 shares; they had three Government nominees on the Board, and these gentlemen were parties to the adoption of the principle of bulk transit on the canal under a system of contemplated exceptional rules, which would disturb the trade in Russian petroleum against the wishes of the largest dealers and refiners of Russian oil, exclusively for the benefit of a syndicate of British financiers and merchants, who, by this private arrangement with the canal, in violation of its charter, had, in effect, obtained commercial advantages and privileges, such as could not have been concluded in any international arrangements under Article XII. of the convention between the nations, that constituted a peril of an international character which should be guarded against. Manifestly there was no danger in the existing mode of carrying petroleum in cases to the East, and no appreciable danger in carrying petroleum in bulk in the Northern and Western waters. Therefore, the danger in the Suez Canal arose from the carrying of petroleum in bulk owing to the abnormally high temperature of the isthmus, the confined space of the water, and the heat of the water itself. These constituted such elements of danger that cargoes of petroleum in bulk, in the event of war or European complications, or internal commotions, would be perforce prohibited by the Government of Egypt as something calculated to threaten the security or the free passage of the canal.

Merchants and tin-plate manufacturers in Wales, and others engaged in the Eastern trades, supported Messrs. Russell & Arnholz to the extent of a resolution in which they declared that "the perilous and precarious system of bulk transit of petroleum would wholly extinguish, without any compensating advantage to the trade in petroleum, a large section of the tin-plate industry, and this, not for the ends of legitimate commerce, but in furtherance of the interests of mere monopolists."

I should also say that, just before the report was prepared, and, indeed, while Sir Boverton Redwood was in Egypt, Sir Marcus Samuel, writing to *The Times*, and fearing a statement not altogether favourable to the unrestricted appearance of tank steamers in the canal, reminded Sir Boverton that, a short time before, he (Sir Boverton) had made the following remarks before the Institution of Civil Engineers:—

"The tank storage of kerosene oil has undoubtedly a great advantage over barrel or case storage in the event of fire. A notable example of the comparative safety of the system occurred during the fire at Dudgeon's Wharf in 1886, when several tanks became highly heated, and in certain instances the contents were ignited, but in no case was any important quantity of oil destroyed, nor was there any serious damage to the surrounding property. A still more marked illustration of the same thing occurred in the fire in Antwerp in 1889. He had occasion to go there immediately after for the purpose of making a report on the occurrence. It would be remembered that it originated from an explosion in a cartridge factory. There was a very large tank nearly full of petroleum, which was to some extent injured by the explosion, but not so as to cause it to leak much. The explosion also ignited a store containing a quantity of mineral oils in barrels. The fire burnt furiously for something like two days, and the direction of the wind was such as to carry the flames towards the petroleum tank to which he had alluded. At a distance of only ten feet from the tank stood a telegraph post, which was destroyed by the flames, and the tank itself on that side was considerably scorched, yet the contents remained unignited, and the oil was found, after the conflagration was extinguished, to be in a perfectly merchantable condition. There have been other examples to which he might allude, but these were sufficient to indicate that there was, as a matter of fact, a great advantage in tank storage from the point of view of safety in case of fire."

(There has been a great change of opinion during the past fifteen years. The tank steamer is neither misunderstood nor maligned. Some shipowners who opposed this type of vessel at the start now run their own tank steamers, recognising apparently that the modern oil-carrier is a safe and profitable cargo vessel. Looking back at what took place in 1892, one finds no difficulty in seeing very good reasons why eminent petroleum authorities desired that all reasonable precautions should be taken to ensure the safety of certain imperfect pioneers of the world's ocean-going bulk oil carriers. Anything like the onerous regulations they recommended for the safe navigation of the first oil-carriers in confined waters would not be suggested by them, and if they were would not be tolerated to-day, when it is acknowledged by the foremost shipbuilding experts of the world that not only can bulk petroleum (if kept intact and not broken) be safely carried in narrow channels, but that it is possible for vessels of this type to load oil and the most delicate of general cargoes alternately. Obviously, the conditions under

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which petroleum is exported have improved in almost every possible direction, scientific, chemical and engineering, and many of the early opponents of tank steamers are now content to agree with oil men when they say that it is in the best interests of this vast and expanding trade that the transport of petroleum through crowded and narrow waterways should be carried on under proper conditions and in such a manner that, while the owners of oil-carrying vessels will have no cause for complaint, the commissioners or companies will have their important interests properly safeguarded. Time and science have worked out a good case for tank steamers, which have many enviable records to their credit.)

A new day is dawning—a day which is witnessing the birth of an idea that will give a new direction to human thought and develop an industry which will forever mark an era in the progress of the world.

J. T. HENRY,
Author of several works on the American petroleum industry in its earliest days.

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THE figures representing the quantity of petrol imported into Great Britain in the past three years were:—

Imported in	1904	30,000 tons.
,, ,,	1905	60,000 ,,
,, ,,	1906	100,000 ,,

The Motor Fuel Union estimates that the demand in the next four years will be:—

In	1907	150,000 tons.
,,	1908	210,000 ,,
,,	1909	280,000 ,,
,,	1910	360,000 ,,

The tank steamers now building are designed for the transport of the most inflammable descriptions of oil, and it will be seen that these—fourteen in number, averaging 8,000 tons each, and making six voyages in a single year—will be capable of carrying 672,000 tons, or nearly double the estimated petrol needs of Great Britain four years hence.

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CHAPTER VI.

TWO hundred and fifty British ship-owning firms doing business with the East, and largely interested in the navigation and traffic of the canal, petitioned against the materialisation of the policy of the Canal Company. They stated that they had been informed that the company were negotiating with a syndicate who desired to obtain permission for the carriage of bulk petroleum on the canal in steamers fitted to carry abnormally large quantities of oil in what were regarded as excessively large tanks. They put forward eight objections to the privileges asked for. The last paragraph of the petition read:—"That provision shall in any case be made whereby the owners of vessels or cargoes sustaining damage or loss by reason of any accident to oil steamers shall be fully indemnified by them against such loss or damage."*

With reference to this petition, the British Suez Canal directors observed that it was marked by some confusion of ideas which had prevailed throughout the letters of their representatives, and, they added, "it would be difficult to understand how so large a body of intelligent and practical men of business could have signed such a document." They pointed out errors and inconsistencies in the petition, and added:—

"The only real danger to the canal and shipping frequenting it would arise from a tank vessel taking the ground so heavily as to require lightening. In such cases ordinary vessels are got off by discharging cargo into barges, but such a process in the case of petroleum would lead to the oil escaping on to the surface of the water, where it might take fire, as has happened in certain cases. To guard against such a danger every tank vessel must have a tender expressly constructed to receive the oil without any escape on to the canal surface."

A circular addressed to the shipowners of France (January 29th, 1892) contained the statement that applications by the Standard Oil Company and a Russian syndicate at Baku for permission to send tank steamers through the Canal had been refused, but that an English syndicate, connected with the house of Messrs. M. Samuel & Co., had "to the general surprise" succeeded in obtaining the desired permission. The steamers which the syndicate intended to build, it was pointed out, might consist of a single shell and contain cisterns of enormous dimensions; these steamers rather deserved the name of floating reservoirs than of cistern steamers. The cisterns were made large enough to enable the steamers to carry return cargoes, and the new idea would interfere unfairly with the legitimate transport of petroleum in cases from Batoum, and of which as many as 10,000,000 were dispatched in 1892.

Others claimed to be heard against the adoption by the Canal Company of a rule permitting the passage of tank steamers on the canal, the chief arguments being that it involved exceptional regulations, compulsory convoyage, and special anchorage in excess of the rights and powers of the Canal Company under the Act of Concession. The memorialists—and they were certainly numerous—pointed out that Article IV. of the Convention read:—"That no right of war, no act of hostility, nor any act having for its object the obstruction of the free navigation of the canal, shall be committed in the canal and its ports of access," and contended that the appearance of tank steamers in the canal could not be legally permitted without the formal consent of the Signatory Powers.

The British Government had the advice of such high authorities on explosives and shipping questions as Sir John Stokes, Colonel Majendie and M. Chevassus. Of the last-named authority, "charged

* The P. and O. and British India, their own underwriters, and indeed all the great passenger steamship companies of that day, held aloof from this second agitation against tank steamers. Moreover, amongst the memorialists were shipowners who, in later years, built tank steamers which they did not hesitate to send through the canal.

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with the investigation of the petroleum question," the British directors of the Canal said, "He knew the points of difficulty likely to arise from the probable conflict of interests of the parties concerned—ship-owners, shipbuilders and merchants."

M. Ferd. de Lesseps, President of the Canal, also took an official part in the controversy. In the preparation of the proposed regulations he and his colleagues had before them the regulations in force in some of the most important English ports, such as the Thames and the Mersey. So far as they were aware, they said, the passage of similar petroleum vessels had been freely allowed in the chief waterways of Euorpe at that time (1892).

One of the papers which expressed intelligent opinions on the subject was *The Economist* * (January 9th, 1892).

* That paper said: "The new scheme is one of singular boldness and great magnitude. Whether it be true, as its opponents insinuate, that it is purely of Hebrew inspiration, we are not concerned to inquire; nor does it appear why such a circumstance should count against it. If simplicity is an element of success, the scheme certainly seems full of promise. Instead of sending out cargoes of oil in cases, costly to make, expensive to handle, easy to be damaged and always prone to leak, the promoters intend to ship in tank steamers, *viâ* the Suez Canal, and discharge wherever the demand is greatest into reservoirs, from which it can be readily supplied to consumers. There is nothing new in the idea of tank steamers, of which there are already a good many; the novelty is rather in the taking of the oil through the canal and disposing of it on the large scale contemplated, and in this the promoters have secured the paramount advantage of a good start. The oil, whether from the Black Sea or from the States, has been carried in cases, through the Canal if from the former, and for the most part round the Cape in sailing vessels if from the latter. All this is to be altered, and if the sanguine anticipations of the promoters are realised the Eastern case oil trade must needs become obsolete. It looks, indeed, very much as if the tank steamer were destined to do for the case trade what Stephenson's locomotive did for the coaching industry. Amongst other arguments used it was, as we remember reading, gravely alleged that the smoke from the Rockets and Puffing Billies would be death to every bird which encountered it. So to-day the tin-plate workers and the shipowners have done their utmost to persuade the Government, the country, and the Suez Canal authorities that the passage of tank steamers through the canal will be a blunder and disaster of the first magnitude. For the tin-plate workers we feel sympathy. For them and their friends the outlook is very discouraging, and in a memorial to Lord Salisbury they say so, like men. It is true that they also advance various forms of the bird-in-the-smoke style of argument, but that it is, after all, the tin-plate industry about which they are troubled they do not attempt to disguise."

Lieut. Alexander Murray, acting-consul at Batoum, in a letter to Lord Salisbury (February 12th, 1892) said, with reference to the advantages or disadvantages likely to follow the adoption of tank steamers for the transport of petroleum to India and the Far East, "Naturally, the opinion of the majority of exporters would be adverse, as it would lessen the large and lucrative manufacture of cases. In England this difference would not be felt, as the oil must be put into cases sooner or later, and the tin-plates which formed so large an article of import to Batoum would be sent direct to India."

During the war which was waged against the obvious intention of the Suez Canal Company to permit the transport of bulk oil through the Canal, Lord Salisbury made it plain in several of his communications to the Shipowners' Association that he supported the action of the Canal Company. In one reply, written on March 26th, 1892, to the Glasgow Shipowners' Association, he said that neither the British Government nor the Canal Company had power to close the canal to any particular class of traffic; neither had the Government power to interfere with a company in regard to the regulation of the traffic, provided that the flags of all nations were treated on a footing of equality. Later (April 12th, same year), Lord Salisbury, acknowledging the receipt of a memorial from Bristol shipowners, said:—

"I am to inform you that Her Majesty's Government are advised that the Suez Canal Company have the power under their concession to make such regulations as may seem to them necessary for the traffic passing through the canal, but that they have not the power to refuse admission to any class of commercial vessels which comply with those regulations. This country is not a party to the company's charter, and so long as the company complies with the provision in that charter, that the flags of all nations shall be treated on a footing of equality, Her Majesty's Government have no power to interfere with the company in regard to the regulation of the traffic which passes through the canal. The directors, being responsible for the safety of the canal and its shipping, have taken all the precautions they consider necessary for preserving it, and the British directors received from Her Majesty's Government the best expert advice at their disposal when the regulations were under consideration by the Company."

After this last word by Lord Salisbury the opposition sent to the Foreign Office a copy of the report prepared by Sir Frederick Abel and Professor

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(now Sir) Boverton Redwood for the British shipowners. An adequate summary of this report follows.

*Local Conditions under which the Transport of Petroleum is conducted.**

The transport of petroleum in bulk, in specially constructed steamers, prevailed very largely in 1892, but in no case had it taken place under conditions which assimilated to those presented by traffic through the Suez Canal, in many respects unique as a waterway. Considering it necessary that, before framing the report, they should make themselves acquainted, by personal observation, with the local circumstances under which the petroleum traffic through the canal was conducted, one of them proceeded to Egypt, where the fullest information was afforded by the officials of the Suez Canal Company in reference to the canal and the management of the traffic.

The Suez Canal, as is well known, has a length of 100 miles. For a portion of this distance, the waterway traverses the large and small basins of the Bitter Lakes and Lake Timsah; the length of the canal proper is thus reduced to about 65 miles. . . . In 1892 "gares," or sidings, afforded accommodation for several vessels proceeding in one direction to make fast, so as to allow vessels proceeding in the opposite direction to pass them. The large basin of the Bitter Lakes presented deep water-way of considerable area, while, through the small basin, there was a buoyed channel 40 metres in width. In some places the canal described somewhat sharp curves, and at some parts there were high banks, which limited the range of vision.

Sir Frederick Abel and Sir Boverton Redwood wrote in 1892:—

During February, March, and April sand-storms sometimes occur, and during the prevalence of a severe storm of this description the air becomes so highly charged with sand particles that navigation on the canal is either impossible, or can only be conducted with extreme difficulty and danger. The occurrence of sand-storms, moreover, occasionally takes place so suddenly, that there is a liability to the grounding or collision of vessels before the traffic can be suspended. The prevailing atmospheric temperature is obviously a point of much importance in connection with the exceptional character of this water-way. At the request of Sir Evelyn Baring, Rogers Pasha, Director-General of the Sanitary and Public Health Department of the Egyptian Government, was good enough to furnish tabulated daily records of the shade temperatures in Suez, Ismalia, and Port Said. These figures show that a high shade temperature prevails on the canal during several months, but the influence of the climate upon the question of risk attending the transport of petroleum in bulk through the canal cannot be considered solely from this point of view; thus the absence of cloud and the small amount of aqueous vapour in the air, especially at the Red Sea end of the canal, are also important factors in arriving at a conclusion as to the temperature which petroleum may acquire, either in the tank ship or if liberated upon the surface of the water. According to the superintendent engineer of the Peninsular and Oriental Steam Navigation Company, the highest recorded surface temperatures are 90°F. in the Suez Canal, and 95°F. in the Red Sea, the observations having been made in both cases at the usual depth. In this connection, it should be borne in mind that, during the flowing of the tide at Suez, water is passing into the canal from a land-locked gulf, surrounded for the most part by a bare rocky shore, which, throughout the day, is receiving the unobstructed heat of the sun's rays. If the difference between the maximum shade temperature and the black-bulb readings in Cairo be added to the maximum shade temperature in Suez or Ismailia, it will be seen that any surface exposed to the sun during the warm months must become highly heated; and, having regard to the limited area of the waterway of the canal and to the character of the banks, there can be no doubt whatever that refined petroleum, if liberated upon the surface of the water at such a season, would very rapidly acquire a temperature at which it would give off inflammable vapour freely, even if it had not already become sufficiently heated to do so while in the tank steamer.

Present Mode of Transport of Petroleum through the Canal in cases.

At that time (same year) refined petroleum was largely shipped from the United States and Russia to the East, *viâ* the Suez Canal, in cases. Sir Frederick Abel and Sir Boverton Redwood said:—

A case consists of a wooden box enclosing two rectangular tin cans, each of four Imperial gallons capacity, the filled cans being hermetically closed by soldering. These packages are shipped by ordinary cargo steamships. Although neither the tin nor the wood employed in their construction is of considerable thickness, these petroleum cases have been found by long experience to withstand even somewhat rough handling without injury, and to be well adapted for the transport of the liquid in tropical climates. The percentage of leaky cases in a cargo is usually very small, and, so far as we have been able to discover, no instance is on record of a fire having occurred on board a steamship laden with case oil while in transit through the canal. During the process of discharging the cargo in port, there is obviously increased risk of fire; and the occurrence of such accidents as the somewhat alarming fire which arose during the unloading of the case oil ship *Aurora* in the Hooghly does not militate against the view that, during transport, the danger of ignition of oil shipped in cases is very small. Assuming a fire to have become well established in a warehouse filled with petroleum in cases, it is evident that the packages described would not offer very much resistance to the flames, and from this point of view, the storage of petroleum on land in properly constructed iron or steel tanks must be regarded as securing a greater measure of safety; but there is a broad distinction to be drawn between transport and

* Report of Sir Frederick Abel and Sir Boverton Redwood on the proposed transport of petroleum in tank steamers through the Suez Canal. Prepared at the request of British shipowners.

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storage. If a fire arose in a full cargo of case oil, where the air space between the vessel's hatches was small, there is good ground for the belief that the combustion of the oil would be quickly arrested for lack of air to support it. The instance of the *Joseph Fish* affords a strong confirmation of this view. Obviously, what has mainly to be feared in such a water-way as the Suez Canal is the escape of burning oil on to the water, and in regard to an ordinary iron or steel cargo steamship, laden with petroleum in cases, it appears reasonable to suppose that if a fire arose a freer access of air than could easily exist would be essential to a continuance of the fire. A serious collision might evidently rupture the hull of a vessel carrying case oil, and the stem of a colliding ship might penetrate sufficiently far to cut into one or two of the vertical tiers of the cases. In this way oil might be set free, but the quantity would be limited to the contents of the cases thus injured."

The shipments of kerosene in cases to the East in 1899, 1890, 1891 were as follows :—

From the	1889. Cases.	1890. Cases.	1891. Cases.
United States.	15,417,479	13,841,075	10,618,028
From Batoum .	4,507,408	6,548,899	7,547,244

System of Transport in Tanks.

For the method of carriage in cases just described it was proposed to substitute, to a greater or less extent, the system of transporting the petroleum in bulk in specially constructed tank steamers. . . . Between sixty and seventy petroleum tank steamships were then employed in the trade, and many of these carried from 3,000 to 4,000 tons of oil.

The possible risks attaching to the proposed traffic were classed by these eminent experts under the following heads :—

(*a*) Fire or explosion occurring on board the petroleum tank steamship.

(*b*) Escape of petroleum from the tank ship through leakage, collision, or grounding, and ignition of the liberated oil.

Accidents of the first class were undoubtedly liable to occur under the climatic conditions prevailing in the Suez Canal during a portion of the year ; indeed, the destruction by fire off the coast of Greece of the tank steamer *Lux*, laden with refined petroleum, though attributable to mismanagement and gross carelessness, as well as, perhaps, to what may be described as faulty construction of the vessel, clearly indicated that such a risk was far from an imaginary one, and it could not be denied that the probability of the occurrence of such a disaster would be increased by the climatic conditions prevailing in the Suez Canal.

Assuming a serious fire to have become established on board a tank steamer laden with petroleum, the character of the injury to other vessels in proximity, and to the permanent accessories to navigation of the canal, obviously depend largely upon the extent to which the burning cargo became liberated ; so long as the hull remained intact, little or no oil could escape, but in such a water-way the removal of the burning vessel would be a matter of great difficulty, if not of impossibility, and if the vessel were to founder while any considerable amount of the cargo remained unburnt, the floating out of the burning petroleum which would ensue could not fail to be a source of great danger, in view of the narrowness of the area over which the oil would extend. Moreover, the removal of the sunken vessel would, in some parts of the canal, be a difficult and tedious operation, during which the traffic might necessarily be entirely suspended. Apart from the development of a dangerous fire on board the vessel, an explosion of a mixture of petroleum vapour and air might take place. No explosion could, of course, occur in the oil tanks while full of oil, and the risk of explosion in the expansion trunks would be very small ; but if oil escaped from the tanks into the bunkers or other confined spaces in the vessel, it would, at the high temperature sometimes prevailing in the canal, be liable to become rapidly converted into vapour sufficient to form an explosive gas mixture with the air in those spaces.

On the return voyage, after the vessel had discharged her cargo, the oil tanks themselves, if not effectually cleansed (a result by no means easy of attainment), would also be not unlikely to contain an explosive atmosphere while the vessel was passing through the canal during the warm months. An explosion occurring on board a steamer laden with oil in bulk might be followed immediately by very serious leakage from the tanks and ignition of the oil ; while if the vessel had discharged her cargo, a serious explosion in the oil tanks would probably cause her to founder.

Accidents of the second class were undoubtedly to be still more seriously apprehended. The normal leakage of oil from petroleum tank ships could not under ordinary circumstances be regarded as a risk worthy of consideration, but if a tank steamer laden with petroleum had met with bad weather, it was quite possible that she might be leaking to such an extent as to be a source of danger when moored for any length of time in those parts of the canal where there was still water. Moreover, it occasionally happened that rivets worked loose and became displaced, and this might occur while the vessel was in the canal. Undoubtedly, however, the most important risk to which tank ships of the ordinary construction passing through the canal with petroleum in bulk would be subjected, was that of injury to the skin of the vessel by collision or grounding, and consequent liberation of the oil. The ordinary regulations for the navigation of the canal distinctly recognised the possibility, if not probability, of the ocurrence of collisions, and it was well known at that time that accidents of this character did occur in the canal from time to time. The risk was therefore far from an imaginary one. Collisions or grounding might occur through carelessness or mismanagement, through the mistaking of signals or orders, through the derangement of steering gear, through the unsatisfactory answering to the helm exhibited by some vessels at the low rate of speed imposed by the regulations, through the failure of the search light, through the effect of a strong wind, through the sudden occurrence of a sand-storm, or through a vessel in a siding being sucked out by a passing vessel, as in the case of the collision between the *Britannia* and

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the *Knight of St. John.* Collisions might take place either between two vessels passing through the canal, or between a tank vessel and one of the dredgers, barges, tugs, house-boats, or launches employed in the canal service. In the widened parts of the canal vessels passed each other anywhere, but the system of navigation adopted in these portions appeared to be less safe, from the point of view of possible collisions, than that which prevailed in the narrow portions. It had been asserted that, owing to the narrowness of the water-way in the canal, it would be impossible for one vessel to deliver a penetrating blow to another, except near the stem or stern, or at any rate not amidships, where the tanks of a petroleum steamer were situated. It was doubtful whether this was quite true of even the narrow portions of the canal, but it did certainly not apply to the sidings or to the widened portion, where there was room for a vessel to get across the water-way to such an extent that she might be struck amidships by the stem of another vessel. Moreover, the oil tanks might be injured to such an extent as to cause serious leakage, without receiving a direct blow from the stem of another vessel, if a tank steamer was subjected to a bumping or gliding collision.

The effect of a comparatively slight collision upon a tank steamer laden with petroleum might be to cause the rapid outflow upon the surface of the water-way of a considerable quantity of the cargo, and if this occurred during the prevalence of a high temperature, it was scarcely conceivable that an ignition of the oil would not occur. The petroleum would very quickly become heated to a temperature at which it would freely give off inflammable vapour, if indeed it was not already in that condition in the vessel, and the vapour becoming rapidly distributed through the atmosphere to considerable distances, its ignition, followed by firing of the oil, would doubtless take place. Practical illustration of the destructive effect of even a comparatively small quantity of petroleum burning upon the surface of the water was afforded in the case of the *Wildflower* at Sunderland. In that instance the liquid implicated was, it is true, crude petroleum; but refined petroleum or kerosene at a sufficiently high temperature, such as might prevail in the Suez Canal, would give practically the same results as crude petroleum at a low temperature. In this connection it should be borne in mind that, on the Suez Canal, vessels could not be turned round, and that they could not readily be driven far astern on such a narrow water-way. Therefore, in the event of a petroleum fire occurring in the canal, vessels in the proximity and heading towards the fire could only be effectually removed by being towed astern.

Having considered the provisional regulations relating to tank steamers, the experts in their important report dealt with the directions in which they considered attempts might be made to minimise the dangers attending the transport of petroleum in bulk. Under this head they wrote:—

"The most serious source of danger to be apprehended is the liberation from the tanks of the oil through collision or through the grounding of a vessel, and although it may be impossible altogether to eliminate this danger, it is possible so to construct the vessels to be employed as to materially diminish the chances of oil being liberated through the above causes. Vessels similar to the *Sviet* and *Bakuin,* or vessels constructed with a double skin, would be obviously less likely to suffer such injury through collision as would lead to the escape of the oil; and, although, in the case of a double-skin ship, it would, of course, be possible that she might meet with a sufficiently serious collision to cause both skins to be penetrated, there can be no doubt that this form of construction would greatly reduce the risk of any considerable liberation of oil on to the water. On the other hand, the adoption of that system of construction is unquestionably open to serious objection; thus the first cost of the vessel would be greatly increased, her carrying capacity would be diminished, the repairs necessary from time to time would be difficult of execution, and the existence of an explosive mixture of petroleum vapour and air between the two skins would be difficult to guard against, except by providing for a very efficient system of ventilating the intervening space. The most practicable methods of reducing the quantity of oil which could escape from a vessel sustaining serious injury through collision or grounding appear to be a considerable subdivision of the tanks by means of vertical oil-tight bulkheads, or the adoption of a cellular system of construction of the oil tanks at the sides of the vessel, with the addition of a double bottom, of the kind suggested by Mr. Swan.

"The utilisation of the spaces alongside the expansion trunks of petroleum tanks as coal bunkers in the tank steamers undoubtedly introduces a distinct element of additional risk, even if the bulkheads forming the after safety space extend to the upper deck, for, if these bunkers are to be used, they must be furnished with doors through which the coal can be trimmed into the stokehold. In our opinion, the tank steamships intended to pass through the Suez Canal should carry their coal supplies aft of the safety space in cross and side bunkers.

"Assuming that it be practicable to adopt a system of construction of tank steamers calculated to greatly reduce the risk of accidental liberation of a large quantity of petroleum oil upon the surface of the water during the passage through the canal, we are of opinion that, under any circumstances, far more stringent regulations in respect to the navigation of the canal by petroleum tank steamers than those which have been proposed by the canal authorities, would be necessary to ensure the conduct of the traffic with reasonable prospects of safety. We would suggest that such regulations should include the stipulations: That all tank steamers should be painted white; that they should, while passing through the canal, be protected with fenders of large dimensions, constructed of cane or other suitable material; that they should be under way only during daylight; that the use of fires, other than the main boiler fires, and lights of any description, except signal lights at night, should be strictly prohibited; that, when vessels are moored at night while in the canal, they should be protected by means of floating booms in the form of iron cylinders of large diameter, and that an officer of the Canal Company should be responsible for the rigid observance of the regulations.

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"The transport of petroleum in bulk in such steamers through a water-way of such exceptional character as the Suez Canal must always be attended with risk of accident to other shipping, and with risk of more or less serious interruption of the unobstructed passage of ships; and we are strongly of opinion that such regulations as those which have been issued by the Suez Canal Company in the form of instructions to captains of vessels using the canal will, of themselves, certainly not suffice to secure prospects of safety such as may reasonably be demanded by shipowners."

The report was sent on to the Suez Canal Company, and M. Ch. A. de Lesseps, acknowledging receipt for the President, said :—

"Without entering into the question whether the work of Sir Fr. Abel and Mr. Boverton Redwood is not merely a criticism of our regulations, bearing too exclusively the impression of the anxiety of parties interested in the present mode of transporting petroleum to the East, we think it right to say that we have discovered nothing in it, so far, that had not received our whole attention during two years which have been devoted to the patient examination of the numerous and varied aspects of the question. We have, nevertheless, added this report to the other papers in the case, and we shall even study it again, because we lose sight of nothing that might assist us in improving our regulations, if experience should show us any necessity for doing so."

In this way the controversy came to an end. The supporters of the movement in favour of bulk oil transport in the canal were successful, for the directors issued regulations for the inauguration of the new trade and steamers started to carry bulk illuminating oil through the canal.

When, in 1892, the *Murex*, on her maiden voyage to the Far East, entered the canal with the first cargo of petroleum in bulk, she solved some of the most difficult problems of canal navigation. Sailing on July 26th from West Hartlepool, she proceeded to Batoum to load Russian oil for Singapore and Bangkok. The day she passed from the Mediterranean to the Red Sea the Shell Company, her owners, won a great triumph—not merely a triumph in the commerce of oil, or the triumph of a shipping innovation, but a victory for Russian oil.

Throughout the important correspondence dealt with in these two chapters it will be observed there are frequent references to the dangerous influence of the canal temperature on any oil which may be allowed to escape on the water. Against the objection put forward by shipowners that the temperature of the canal was too high for the safe passage of tank steamers, and that the admission of these vessels would be fraught with great danger to life and property, it should be pointed out that a physical chart of the world shows that during July the oil regions of Pennsylvania and Ohio, the port of Philadelphia on the west, and the port of Batoum and Suez on the east, all lie between the isotherms of 70 and 80 degs. E., and that New York, Philadelphia and Batoum are much hotter in the summer than the canal. Not only can a tank steamer when aground lighten herself by discharging part of her cargo, but in a collision in the canal the contents could escape without any risk of fire, unless it were heated to at least 120° F., when, probably, the volatile vapours would be generated. The ordinary "tramp" of 1892, laden with case oil, was a more likely source of danger than a tanker, as the wood in which the cases were enclosed formed an excellent medium for starting a fire. To prove this contention it has been pointed out that if a gallon of oil were emptied on the cases the ship and her cargo would be set on fire; while an incendiary, even if he possessed the necessary technical knowledge, would find it nearly impossible to set fire to a cargo of refined oil in bulk.

* * * * *

"The supply and price of American petroleum is regulated by the operations of the Standard Oil Company—the most powerful trade combination in existence. As free traders, we are not naturally disposed to regard with favour any monopoly; yet it is but just to say that this great corporation has so far used its vast powers with judgment and discrimination, and it is a wonderful example of trade regulation, without doing harm either to the producer or to the consumer. The supply and price of Russian petroleum is regulated by the Russian house of Nobel Bros. and the equally great Paris house of the Rothschilds. If the president of the Standard Oil Company and the representatives of the other two houses could arrive at some permanent agreement the world would witness a financial operation of the most stupendous magnitude. An agreement has so far not been possible, because the interests of Nobel and Rothschild are not identical with those of Rockefeller. . . . The reasons for this want of agreement are not far to seek. There are three great foci of petroleum in the world—the one in North America, which extends from Pennsylvania to North-west Canada, practically from the Atlantic to the Pacific; one in South America, and one in South-east Europe

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and Western Asia. Batoum is nearer the Indian and Chinese markets than Philadelphia by 120 degs. of longitude. A little consideration will show that petroleum in the East is much dearer than it need be. Tin is carried from Singapore to Great Britain, and in conjunction with our native product, it is manufactured into tin plates, which are sent to South Russia and America. At Batoum and Philadelphia the tin plates are made into cases, filled with oil, and sent all over the world. In the case of America, the tin makes two journeys across the Atlantic. It pays duty subject to a drawback, and is worked up by highly paid American labour. A cheaper method would be to send the oil in bulk from the States to Great Britain, do the canning and packing on this side, and then export the finished article. The cheapest of all is to send the refined oil in bulk from Batoum through the canal and perform the canning operations at the ports of distribution in the East. By this means American oil would be unsaleable in the East on account of its high price. Thus, it is easily seen that the latter proposal has been received with the most intense hostility by the American producers, because they will lose the Eastern market; by the Welsh tin-plate manufacturers, because a good deal of their trade will be diverted; and by English shipowners, who will lose a source of profitable employment for their vessels.

. . . . .

"It is not a little curious to note the change of opinion that has taken place during the past year with regard to petroleum. A year ago, when it was sought to inflict a wholly unnecessary measure upon the petroleum trade, called the Inflammable Liquids Bill, petroleum merchants, shipowners, brokers, *et hoc genus omne*, testified loudly that petroleum was a perfectly safe article under any and all conditions. Now, when it is sought to send oil in bulk through the canal, we are gravely told that it is dangerous, and one would think that certain daring spirits had proposed to line the canal with submarine mines; and all this, as the Welsh tin-plate manufacturers so pathetically put it, 'to the grievous loss of the present safe mode of trade, which would be extinguished.'"

* * * * *

The above extracts are from a statement written by an able and warm defender of tank steamers at the time of the Suez Canal controversy. They throw light on some of the chief trade features of the controversy. Half-way through the eighties petroleum transport in bulk was little better than a theory; there was not a record of success to justify the enterprise of the pioneers, and nothing very convincing could be said on their behalf, either by those who completed the "conversions" or those who took them to sea. Vessels of the "converted" class did not altogether justify the expectations of their owners.

Twenty years ago, five years before the Suez Canal controversy, the transport of petroleum in bulk was in actual practice discovered to be dangerous, but the accidents of that time—certainly those of the *Wild-flower*, *Tancarville* and *Lux*—were directly due to imperfections in design and workmanship; and the particulars of catastrophes in the running of some of the early tank steamers were published broadcast as an argument that oil could only be safely handled in tin cases.

Even when the Standard Oil Company made overtures to the Suez Canal Company some of the oil-carriers were not safe enough to escape expert criticism, and shipowners, easily convinced that they were not suitable for canal navigation, had no great difficulty in making out a case against a concession to the Americans.

Indeed, remembering what kind of vessels some of them were, it says very much for the unceasing watchfulness of those in charge that more accidents did not occur. The officers were dealing with quite a new form of cargo requiring almost as great care as gunpowder. With their lack of experience they did not know how far the explosive vapours would carry; they did not appear to have grasped the idea that the flame-carrying power of petroleum vapour when mixed with air is extraordinary. Moreover, several of these "converted" ships had notoriously defective electric lighting arrangements; on others the engineers understood very little about the new system; while there were oil-carriers which were not electrically lighted.

It is also to the credit of the pilots and those in command of tank steamers that there have been no collisions, and, with a single exception, the case of the *Nerite*, no serious conflagrations in the Suez Canal.

There are tank steamer captains who, even to-day, sum up the question of danger in this fashion: In confined waters these steamers, in a collision, are more dangerous than vessels which carry general cargoes, but in the open sea they are all right. The risks are external; struck by another vessel a tank steamer, if she empties any of her tanks on confined waters, is a source of danger, but if any accident of this kind

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occurs at sea the oil spreads and there is an absence of danger. But if it is true that the dangerous vessels of the oil-carrying fleets were those of the "converted" class placed in the trade before 1886, it is equally true that the history of the tank steamer, up to the present day, proves that bulk oil, properly handled, is a safe cargo; that it is less likely to be fired than a cargo of cotton; and that it is, if anything, less dangerous than a general cargo. The modern tanker is one of the safest ships at sea—is, in fact, the lifeboat of the mercantile marine.

Opponents of the innovation were only too pleased to recall the accidents to the earliest vessels, and did not follow the successful employment of a number of tank steamers placed in the trade after the Standard's application was refused and just before the controversy started in this country. Between 1888 and 1892 some thirty splendid tank steamers (all built before the Shell Transport and Trading Company got their first vessel, the *Murex*, in 1892) had been built by Messrs. Armstrong, Whitworth & Co., Messrs. Palmer & Co., and other shipbuilders, and were trading with complete success in all parts of the world. The tank steamers built in 1888–9 included the *Genesee*, *Ottawa*, *Suwanee*, *Russian Prince*, *Lumen* and *Elise Marie*, all employed in the oil-carrying business to-day. The records of the few first years of these splendid vessels were overlooked by those who were anxious to make use of the mishaps to vessels of the "converted" class.

Even the warmest supporters of tank steamers, while they found little difficulty in proving that oil as a fuel and a cargo was one of the most valuable liquids of commerce and industry, were not altogether successful in their first attempts to show that, when properly handled, it was also absolutely safe.

The tank steamer was exceedingly unpopular. She was the first steamer on the shipowner's black list, and in the days of the "converted" steamer and the pioneer bulk oil-carrier, "old salts" declared that they were dangerous. The antipathy of seamen towards tank shipping was of the bitterest kind; for a number of years American sailors furiously assailed British-owned oil-carrying vessels, and spread abroad slanderous reports about their unseaworthiness and dangerous occupation.

By a peculiar process of nautical reasoning, the conclusion was arrived at that amongst the manifold dangers run by the steamers was the one of being specially liable to be destroyed by lightning. Time has proved these fears to be groundless.

An oil tanker might possibly be struck by lightning, but there is no ground for the assertion that she is specially liable to sustain damage in that way, although in the case of oil wells and storage tanks cases are by no means uncommon. A steel vessel enjoys almost a perfect immunity from lightning discharges. Sir William Thomson, the great authority on all subjects connected with magnetism and electricity, says a sheet-iron house is the very safest place in a thunderstorm, and advocates that all powder magazines should be constructed of iron throughout. Considering that an oil tank steamer is wholly constructed of iron or steel, and that it floats on an excellent conducting medium, we may safely dismiss all fear of explosion of oil or vapour through the agency of lightning.

In our only English canal the tank steamer met with opposition. When the question of bringing petroleum in bulk up the Manchester Ship Canal was first mentioned the proposal was regarded in the light of a possible forerunner of danger and disaster to the water-way and its shipping. There has been a great change of opinion at the Mersey and canal ports since then. Tank steamers are specially built and regularly tested to obviate any possibility of leakage, and the only mishap to a steamer of this type in the canal would be caused by her grounding badly, damaging the hull and causing serious leakage, or colliding with another vessel. Thanks to the care with which these vessels are navigated, accidents of this class are unknown at Liverpool and Manchester, and the special training of officers and the precautions adopted by the Canal Company are of such a character that serious mishaps are practically out of the question.

The same applies to all English ports entered by tank steamers. At these legal precautions and regulations to prevent disasters are becoming less necessary every year, and it is also interesting to notice that there are now no onerous underwriting and insurance disabilities, the premiums being on a level with those of mail steamers.

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OIL TRANSPORT THROUGH THE SUEZ CANAL.

The following is an official list of the oil-carrying steamers which passed through the Suez Canal from 1892 (when the first steamer, *Murex*, was allowed to enter) to 1906.

Names of Steamers.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	Total No. of Voyages
Appalachee	...	...	...	...	...	...	...	...	...	...	...	...	3	2	...	5
Ashtabula	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1
Astrakhan	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	2
Baku Standard	...	...	...	...	...	...	...	...	3	3	...	...	...	...	...	6
Batoum	...	...	...	...	...	...	...	1	1	4	1	...	1	...	...	8
Bloomfield	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1
Broadmayne	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1
Bullmouth	...	1	2	2	4	3	2	3	3	3	1	4	1	1	...	30
Bulysses	...	...	...	...	...	...	...	...	1	3	2	1	1	...	...	8
Cardium	...	...	...	...	...	...	...	...	1	1	...	2	2	1	...	7
Clam	...	2	3	3	2	3	3	1	1	1	1	...	...	...	...	20
Conch	...	3	2	2	3	2	4	2	2	...	3	2	...	...	...	25
Cowrie	...	...	...	...	2	2	2	3	3	2	2	2	2	...	...	20
Dakotah	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	2
Elax	...	1	2	2	3	3	3	2	3	4	4	1	2	...	...	30
Euplectela	...	...	2	3	3	3	3	3	3	3	2	2	...	...	...	27
Georgian Prince	...	...	...	...	...	...	...	2	...	2	1	1	1	...	...	7
Goldmouth	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1
Haliotis	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1
Hounslow	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1
Housatonic	...	...	...	...	...	...	...	...	...	...	...	...	2	3	...	5
James Brand	...	...	...	2	...	...	...	1	2	2	1	1	1	...	...	10
J. B. Aug. Kessler	...	...	...	...	...	...	...	...	...	...	...	2	3	2	1	8
Lackawanna	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	2
Meteor	...	...	...	...	...	...	...	...	...	1	...	1	...	...	1	3
Mexican Prince	...	...	...	...	...	...	...	3	4	1	1	1	...	...	...	10
Mira	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1
Murex	1	3	3	2	4	4	3	4	1	1	1	1	...	1	...	29
Nerite	...	...	...	...	3	2	2	3	3	4	1	...	...	...	...	18
Pectan	...	...	...	1	2	2	1	...	...	...	...	...	...	...	...	6
Perlak	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1
Pinna	...	...	...	...	...	...	...	...	...	2	...	...	2	...	...	4
Prudentia	...	...	...	...	...	...	...	...	2	1	...	...	...	...	...	3
Robert Dickinson	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1
Rock Light	...	...	...	...	...	...	...	...	1	1	...	...	1	...	...	3
Sabine Rickmers	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	1
Salahadji	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1
Seminole	...	...	...	...	...	...	...	...	...	...	...	...	2	1	1	4
Spondilus (old)	...	1	2	3	...	...	...	...	...	...	...	...	...	...	...	6
Spondilus (new)	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	2
Strombus	...	...	...	...	...	...	...	...	2	3	1	1	2	1	...	10
Sultan Van Langkat	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	2
Telena	...	...	...	...	2	2	3	2	2	2	3	3	1	...	...	20
Tioga	...	...	...	...	...	...	...	...	...	1	...	...	2	1	...	4
Tonawanda	...	...	...	...	...	...	...	...	...	...	...	1	2	3	1	7
Trigonia	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1
Trocas	...	2	2	3	2	3	2	3	1	3	2	2	...	...	...	25
Turbo	...	3	2	1	3	2	2	3	2	2	4	2	...	...	...	26
Tuscarora	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	2
Vedra	...	...	...	...	...	...	...	...	2	1	4	1	1	1	...	10
Volute	...	1	2	2	3	4	2	3	1	2	3	2	...	...	...	25
Washington	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1
Winnebago	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1
TOTAL	1	17	23	28	36	35	34	41	45	54	38	35	37	21	10	455

Roughly, these steamers transported 2,000,000 tons of oil.

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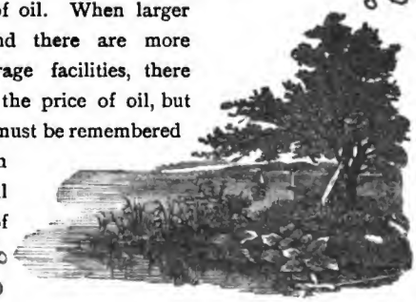
THE marine part of the oil business has become one of considerable importance, financially and nautically. In its inception, steady expansion and adaptability to the peculiar needs of the industry it is acknowledged to be one of the greatest successes of the world's mercantile marine. Per ton the tank steamer costs more than the ordinary cargo carrier. Having a more expensive and complicated equipment, the up-keep is greater than that of the ordinary freighter, and calls for the display of engineering and scientific knowledge unique amongst specialist work in the art of shipbuilding.

It is the heavy expense of fitting up these vessels that compels the owners to charge comparatively high prices for the transportation of oil. When larger fleets are employed and there are more complete terminal storage facilities, there will be a decrease in the price of oil, but this will take time as it must be remembered that the transportation charges per mile for oil exceed the freightage of coal.



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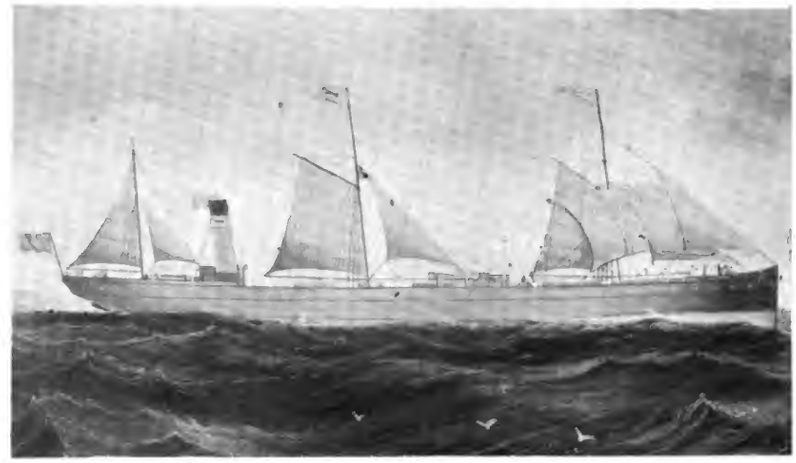
ONE of the earliest of the British tank steamers was the *Tancarville*. We get some idea of the life of a steamer of this type if we take the career of this vessel. In her case launched in 1889 by Messrs. Craig, Taylor and Company, and converted into a floating oil depôt by Smith's Dock Company in 1905—some sixteen years was the limit, although vessels like the *Broadmayne* (1888), still trading, show that they can be kept in this trade for a longer period. The *Tancarville* was run as long as possible in competition with the modern steamer. After having been laid up in the Tyne, her boilers and machinery were removed and she was converted into an oil depôt for permanent service at North Sumatra. The towing of the hulk out to North Sumatra, 8,200 miles, was entrusted to Mr. William Watkins, tug owner, London. The vessel left Shields Harbour in tow of the tug *Columbia* on April 13th, 1905, and arrived at Portland on the 16th. The tug *Oceana* the largest tug in Mr. Watkins' fleet—relieved the *Columbia* and started on the 17th with her huge charge on this long tow. Algiers (1,500 miles) was reached in ten days. The vessels arrived at Port Said on May 18th, 1,516 miles; Aden on the 17th of the same month, 1,410 miles; Colombo, June 2nd, 2,100 miles; Pankalanbrandan, June 10th, 1,212 miles. The actual time occupied in towing was forty-five days.

If space permitted, I could write several chapters on oil hulks; these obsolete craft form part of the huge oil storage systems which have dotted the world with thousands of depôts and countless tanks. The *Kaimiloa*, the only naval vessel ever owned by the Hawaiian kingdom, is an oil hulk in the harbour of Honolulu. The *Kaimiloa* was originally a coal collier running in the English coasting trade. She was purchased for Kalakaua, and made the flagship of the navy, and was, in fact, the whole navy. She carried the Hawaiian Embassy that went to Samoa to negotiate the treaty with the Samoan kingdom, which was to inaugurate Kalakaua's policy of the "primacy of the Pacific" for Hawaii. On her return she was allowed to lie in the harbour, gathering barnacles. A few years later she was sold to the Inter-Island Steam Navigation Company, which, however, never found any use for her until the introduction of oil for fuel in the Islands, when she was employed to carry oil from the tanks to vessels in the harbour.



TANCARVILLE.

As she appeared when she was owned by Mr. Suart, eighteen years ago.

ROTTERDAM.

JOHN BOWES.

The centre picture shows the tank steamer *Rotterdam* towing away from the yard of Palmer's Shipbuilding and Iron Company. She occupied the graving dock of this company for 137 days after grounding on the coast of Newfoundland.

The *John Bowes*, the first iron screw collier, leaving the Tyne. On the left is Tynemouth Castle. Designed by the late Sir Chas. M. Palmer, she was launched at Jarrow on June 30th, 1852, twenty years before his company built the first tank steamer *Vaderland*. These are two of many notable records achieved by this famous shipbuilder.

[*To face p. 58.*

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CHAPTER VII.

Some Problems of Stability and the Arrangement of Bulkheads.

FOR many years after the first steam collier, the *John Bowes* (1852), was built by Sir Charles Mark Palmer, but well before the same great shipbuilder launched the tank steamer *Vaderland* (1872), ordinary freighters were turned out of British shipyards from designs prepared on the rule of thumb principle. There was a time when, according to Mr. Little, "any retired tradesmen who wish to dabble in steamship owning thought himself competent to fix the dimensions and design of a vessel," and, unfortunately for mercantile Jack, there were builders who cheerfully undertook to build these dangerous specimens of primitive naval architecture.

Lloyd's, and a host of original investigators in every branch of engineering and shipbuilding, worked out the principles of correct and safe construction in relation to those forces which act upon a ship at sea. Since the first tank steamers were built in British shipyards, it cannot be said that any single vessel has really been a contradiction of the true principles of naval architecture or a reflection on the ability of her builders, although some have not given the best results. When Mr. Little stated that some of the first petroleum vessels were fearful and wonderful examples of "how not to do it," he evidently referred to the oil-carrying sailers, the *Crusader* and others, which had an elaborate system of cylinders and piping arrangements, the object being to divide the cargo into small lots and prevent leakage.

It can be said respecting the modern tank steamer that the cattle, lumber and cotton carriers are inferior to her if the verdict is given on the value per ton, the general finish of the job, and even on the speed.

The problems of the stability of early tank steamers have been exhaustively investigated by Mr. Martell, Professor Jenkins, Mr. Little, Sir Fortescue Flannery and others, whose writings and opinions are familiar to most of those who are interested in the marine branch of the petroleum industry. Professor Jenkins published the results of some interesting investigations of the stresses produced in bulkheads in oil-carrying steamers. He did this before continuous expansion trunks were adopted, eighteen or nineteen years ago, because neither the *Bakuin* nor any of the converted vessels of that day were constructed on that principle.

Professor Jenkins said :—"During the process of filling or discharging a bulkhead can never have to withstand the pressure of a greater head of oil or water than that corresponding with the level of the oil or water in the expansion spaces. At sea, so long as adjacent compartments are full, the dividing bulkhead can have very little stress to bear, as it is pressed about equally on both sides. The bulkheads which bound the oil hold, having the oil on one side only, are subject to considerable stress, and more especially the aftermost, on account of its greater breadth. The bulkheads which bound the water ballast tanks, when these are filled and the vessel is light, are liable to strain in the same way. But the pressure due to the head of oil or water, as the case may be, does not represent the whole pressure which a bulkhead has to bear. Let us suppose a vessel laden and about to start on her voyage. As she acquires a forward motion each element of the cargo has to acquire an equal velocity in the direction of motion. Ordinarily the force causing the onward motion is communicated to the vessel herself from the shaft through the thrust block to the hull, and from the ceiling and decks to the cargo by virtue of frictional resistance. But with liquid cargoes this cannot be so. This will be well understood if we take the case of a vessel containing free water set in motion. The water will not at first partake of the motion of the ship, but will move aft, heap itself up against the aftermost bulkhead of the compartment, and present to the eye an inclined surface. In such a case the bulkhead has to supply the

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necessary accelerating force to the water, and in doing so is itself strained. Similarly, in an oil vessel, owing to the fluidity of the cargo, nearly the whole of the force necessary to cause the oil to acquire onward velocity at the same rate as the ship herself has to be communicated through the medium of the bulkheads. As the vessel begins to move, the oil in each compartment lags and presses against the bulkheads which are to some extent deflected, and when the increase of stress is just that caused by a pressure great enough to communicate the necessary increment of velocity to the oil, it yields no more. It might at first sight be thought that the pressure on the bulkheads from this cause as we move aft will be intensified—that the pressure on the bulkheads on the after side of the foremost compartment, for instance, in causing it to deflect, would be communicated to the next department, and so on, and that there would thus be an accumulation of pressure on the aftermost bulkhead. No doubt if the tanks were filled and sealed some such action would take place ; but since the oil surface in each tank is free, the bulkhead is free to deflect, and any such deflection is measured by a slight rise in the level of the oil in the expansion chamber. Practically, therefore, the increase of pressure on the aftermost bulkhead of each compartment from this cause is due almost entirely to its own contents. The effect in moving ahead is to increase the stress in the divisional bulkheads, although the increment is usually not great. The aftermost bulkhead is in this way subject to a pressure greater than that due to the head of oil in the reserve tube, and the foremost bulkhead to a pressure somewhat less. When the vessel is being brought to rest the bulkheads separating the oil compartments are strained in the opposite way ; the actual stress on the foremost bulkhead is increased while that on the aftermost is diminished.

"Again, if we suppose an oil vessel to be rolling in the trough of the sea, and to partake of the orbital motion of the sea water, the effect is to increase the apparent weight of the oil when the vessel is in the trough of the wave by as much as, in some cases, 20 per cent., and to diminish it to a corresponding extent when the vessel is on the crest. Practically, the effect of the alternate increase and decrease in the apparent weight affects only the bulkheads bounding the oil hold, increasing the pressure in the wave trough nearly to an equality with that due to an equal head of water, and similarly decreasing it on the wave crest. In the same way on the return journey the bulkheads bounding the water ballast may be subject to stress due to the pressure of a liquid of proportionately greater density than water.

"But although the stresses due to these causes are important in themselves and deserve consideration, it is not for the purpose of withstanding these alone that bulkheads of oil-carrying steamers need to be specially strengthened. A more serious condition of affairs would be reached if by any accident a compartment became only partially filled at sea, owing to the longitudinal motion of the fluid caused by the pitching and ascending of the vessel in crossing waves, and it is mainly to provide against this contingency that the elaborate arrangements in most oil steamers are due. In any case, however, the bulkheads which should receive most attention, those which should be most carefully strengthened, are the two which bound the cargo hold, as well as those which bound that part of the hold intended for ballast on the return journey. Whatever may be the condition of affairs the intermediate bulkheads can never possibly be subject to straining action to the same extent as the ones just mentioned."

This was written before the desire for cheapness of construction led to the introduction of the continuous trunk system. There is no doubt this system gives the greatest strength consistent with the cheapest method of construction. The original idea was that the line of the side of the expansion tanks being continuous, they formed girders the whole length of the oil space of the steamer, but in practice this strengthening is largely discounted by the great send of the oil when the steamer is working in a sea-way. Every time the steamer pitches, the oil is thrown forward against the deck and forward bulkhead, and if the pitching is very heavy, straining takes place. Theoretically, steamers without cofferdams should be stronger, as the weight is in one continuous line without any break ; but, in practice, steamers with cofferdams strain less than those which are without them.

It was the experience of those in command of pioneer oil-carrying vessels that in the matter of stability they differed from the ordinary type of cargo steamer. With ordinary cargoes a vessel's stability is most taxed when rolling heavily. She requires a sufficient range to provide a margin against the heave of the sea, the inclining effect of the wind pressure, and the shifting of cargo. While loading or discharging no great amount of initial stability is necessary, and if she does take a list through an

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unequal distribution of cargo, it becomes so apparent that the necessary steps may be taken by regulating the stowage to restore her to the upright. A tank steamer is in a somewhat different position at sea. So long as the tanks remain full, shifting of the cargo is impossible; but, on the other hand, if from any cause a subsidence in the level of the oil takes place, shifting occurs with a rapidity unparalleled in the case of non-liquid cargoes. With free oil the slightest inclination causes a corresponding change of surface. The most obvious way of minimising the danger, next to careful workmanship and sufficiently close rivetting, is to divide the cargo hold so as to restrict the area affected in case of leakage. In the first oil-carriers this result was most effectively attained by fitting a practically oil-tight middle line bulkhead, which had a most important effect in conserving a vessel's stability. Numerous transverse bulkheads, while they had no such effect as the middle-line bulkhead in respect of transverse stability, limited the area over which leakage extended and reduced the straining effect of a longitudinal motion of the cargo.

But while the earliest oil steamers were particularly safe at sea as regards stability, so long as the level of the oil did not fall, and could steam with a smaller curve than most other classes of vessels, it was during the process of loading or unloading that the need for large initial stability and effective longitudinal subdivision was most felt.*

In practice the number of tanks that may be simultaneously filled increases as the loading proceeds, and the number that may be simultaneously discharged decreases as the vessel rises out of the water. It is not difficult in any given case to draw up regulations ensuring that a vessel may be loaded or discharged with the greatest rapidity consistent with safety. Indeed, in this respect, as well as in respect of her stability at sea, the problem of the oil steamer is much simpler than that of the ordinary cargo-carrying vessel. The latter is engaged as the market demands, seldom carrying two cargoes alike, and frequently shipping mixed cargoes, the scattered arrangements of which it is impossible for the naval architect to anticipate by calculation in any estimate of stability. The tank steamer carries a definite quantity of homogeneous cargo-oil, and is capable of having her stability pretty correctly determined.

Professor Jenkins, in his day, advised that the following information should be given to the captain by the designer of the vessel:—(1) The number and positions of the tanks to be simultaneously filled at the loading port from the commencement of the loading to its completion. (2) The number and position of the tanks to be simultaneously emptied at the end of the voyage from the commencement of the discharge to its completion. (3) The number and position of the tanks to be filled with fresh water for the return journey, so as to give a proper trim and sufficient stability, together with the order in which they should be filled. (4) The order in which the fresh water (ballast) tanks should be pumped out on arrival at the loading port.

* * * * *

Middlesbrough was one of the first shipbuilding towns in the north to earn a reputation for record achievements in tank steamer building, and to it belongs the honour of having sent the first bulk oil steamer, the *Fergusons*, across the sea.

An early connection with the oil transport business led Tees and Wear shipbuilders to make a special study of this kind of work. They did this in real earnest about 1893, just after the Suez Canal controversy had been brought to a close, and it must be acknowledged that they put into practice certain theories and opinions which must always form important pages in any history of oil-carrying shipping. Some of these I have secured for reproduction in this work.

We get some idea of the early systems of construction by examining the opinions of such a high shipbuilding authority as Mr. E. H. Craggs. In 1893, when there were 100 oil-carrying steamers afloat, he was able to give information based on the results of the running of the *Atilla*, *Henri Rieth*, and other steamers built by his company. On the subject of oil-tightness—then and now the watchword of the whole system of construction—he pointed out "that the shipbuilder may design and elaborate, ventilate and electric light, introduce the most powerful and complete pumping system, and put in cofferdams, and yet fail if absolute tightness is not aimed at." Then, speaking of the methods of that day, he said:—

"All edges to be caulked must be brought evenly and fairly together, and the distances between rivets, centre to centre, honestly measured. The two-foot rule, with a piece of round, soft chalk and a wet thumb method must be shunned as a plague. Dressed wooden pattern laths, having holes laid off in the drawing office, and carefully bored to suit all arrangements of rivetting, should be given out to be applied

* The tank steamer *Paula*, lying in the Kaiserhafen, had a list to port. While some water was being pumped into the starboard ballast tanks she suddenly fell over to starboard and struck against the quay wall.

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to the plate edges by the platers, and the marking tube must be carefully used. In the oil-tight parts of the vessel, the rivets are spaced closer than the parts touched by water only (approximately three diameters centres against three and a half, or one more rivet in six, in chain rivetting). As a general rule, single rivetted laps are avoided. It is important to see that the counter-sinking tools and rivet-making does correspond. The stiffening of the plating must be evenly distributed, to prevent slipping or gaping at the caulked edge. In fact, we want sound caulking carefully preserved; rusting up will not come to the rescue in dealing with petroleum. It is necessary to dispense with all edge to edge butts, and overlap all joints including the thick keel stroke."

Here is his description of the risks of straining :—

"But we are aboard of a tanker in mid-Atlantic. We have 5,000 tons of oil on board, in addition to 200 tons of coal, and at any given moment we are battling with thousands of tons of moving water. Now the keel is exposed for a few seconds nearly a hundred feet from the stem, and just afterwards out comes the propeller whizzing round, and huge masses of water fall on the decks forward. For a few moments the water seems to leave half the broadside of the vessel, with its immense outward pressure due to the oil sustained on the rivet heads, and then the huge tanker plunges quiveringly into a great head sea. This is the picture the shipbuilder must keep before him in the drawing office and in the shipyard; it is in a situation like this that he finds himself face to face with the real problems of his great calling. The structural strains upon the ship in a sea-way must be taken up as far as possible by the framework of the vessel so that the rivetted joints are not disturbed. It will be recognised that the work thrown upon the cross bulkheads is of the most severe character, the ship's broad sides, the great flat bottom and the decks, all call simultaneously for support in their own struggles. For this reason they must not be too far apart. The horizontal girders, attached to the cross bulkheads, should be so arranged as to take up the work, whether it is to resist a pull or a thrust between the two sides of the vessel, and, to distribute their effort, a good connection to the side stringers of the vessel is necessary. Similar service is also required from the girder plates placed vertically against bulkheads, with relation to the bottom plating and the deck. The verticals are worked at their feet into the keelsons, which are, in turn, well secured to the floors and bottom plating. But, in this direction, the longitudinal bulkhead gives great assistance. The only way to avoid local movement at the joints, heavy shearing strains in the rivetting, or pulling on rivet heads which hold oil-tight joints, is to adopt the generous principle of binding the whole framework of the ship's hull and bulkheads well together, so that any strain is at once distributed over such a large area of rivets that no single rivet gets seriously tried. Where angle iron joins two plates at right angles, forming a corner, the angles cannot be left to preserve the square shape of the corner; this must be done by knees at suitable intervals. Observe this arrangement in the various plans. Any neglect of this very simple method will be very quickly punished by yards of sprung caulking. The most serious of all duties imposed upon a tank steamer are connected with the proper carrying of her water ballast when making for the loading port. To get a good trim the oil tanks must be used for this purpose. Various methods have been employed, and some experiments carried out at sea in bad weather (including carrying the huge tanks half full of water for days; as if a stormy Atlantic outside the vessel were not enough another stormy sea is created inside) have been most disastrous to the structure of the ships, more especially where the bulkheads have been very far apart.

"One very bad method of carrying ballast is to fill up the alternate tanks. The irregular and injurious strains set up in a rolling ship are very obvious. All this, combined with the occasional filling and emptying of tanks at sea, either to correct the trim when the bunker coal has been shifted or used up, or to improve it in bad weather has, from time to time, caused enormous and costly repairs to be carried out. I am confident, however, that the present somewhat unscientific doubling of strengths here and there and everywhere, the multiplying of rivets, and increasing the size of brackets, until they become vast triangular plateaux, will tone down, and I have hopes that a more commercial oil steamer than it is possible to build to-day will be designed in the near future.* I have been urged, by people who ought to know, to fit a water-tight flat low down in the vessel's hold so that the lower portion of the tanks may be used for ballast. I have advised owners now to adopt this style of carrying ballast. Such a vessel would nearly roll her decks off in a cross sea.

"In the first days of building these steamers there was a great deal of talk about the sin of cutting away

* Mr. Craggs was speaking in 1893.

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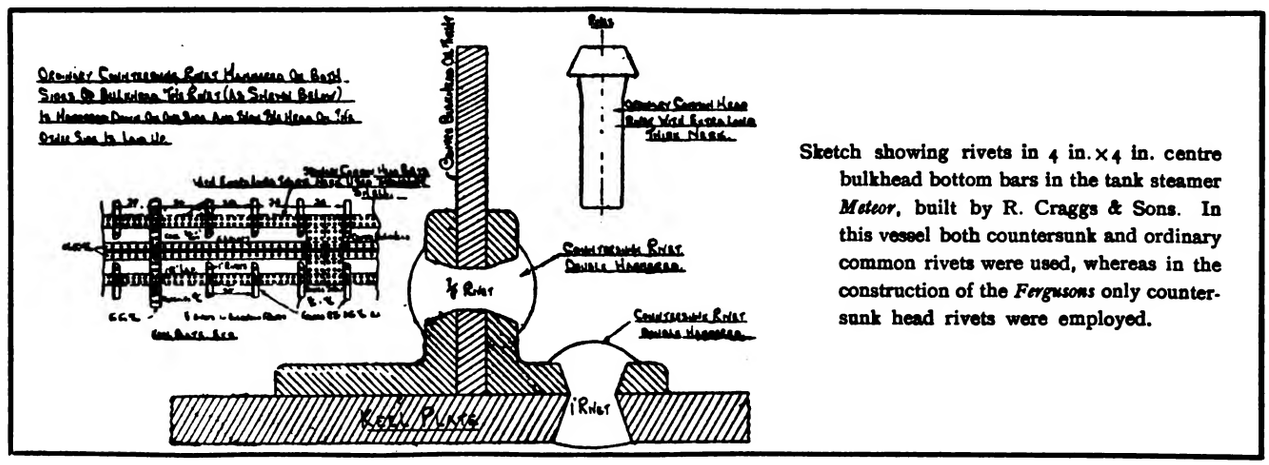
all fore and aft stringers and keelsons to admit of a good clean collar being carried right round the margin, which almost invariably consists of a 5 by 5 steel angle, double zigzag, rivetted in both flanges. It was also said the ring of close-spaced rivet holes almost cut the ship through. But these difficulties can be properly met if we do not overcrowd the rivets through the shell, and if, in addition to using large knees for connecting the stringers and keelson, smaller intermediate compensating knees are fitted. I have found this a most efficient method. Some defects discovered in bottom corners of bulkheads, near the keel plate, have led to the adoption of a centre keelson carried through the bulkhead. I am inclined, however, to favour the breaking of the keelson, and to look for the cause of the defects I allude to in another direction. It has become the practice in some yards to carry two plate stringers through the bulkheads and fit angle collars, thus dispensing with knees. I would rather keep these knees.

"Too much care cannot be taken with the rivetting. For any thickness of plating above ⅞ in. the pan-headed rivet with a swollen neck, set to a certain taper, is best and most favoured by Lloyd's. (*See* sketch.) For ⅞ plating and under we find nothing to beat the countersunk-headed rivet. Much care must be taken to get the countersunk in the rivet and in the plates to be joined to correspond and to ensure the holes being well filled. I have known the countersunk-headed rivet used with good results."

In 1893, Mr. J. H. Boolds (Sir Raylton Dixon & Co.), said on this subject :—

"In a vessel we have built pan heads have been used throughout all the frame attachments to the shell, including the frame angles for the oil-tight bulkheads. The portion, however, of the bulkheads between main deck and spar deck was rivetted with countersunk rivets. We found on testing the tanks that every rivet in this latter portion was perfect, and that where we had to overhaul was the portion of the bulkheads where pan heads had been used. I must admit very few required touching up; but, as I stated, none of the other type gave any trouble. If we had another oil steamer to build we would have this question looked thoroughly into before commencing the work. I may add that in the construction of this ship we have absolutely dispensed with the use of canvas, felt and other similar stopwaters."

During the progress of this battle of the rivets in North of England shipbuilding centres, Mr. W. M. Ruthven was one of those who experienced a great deal of trouble with the pan heads, but very little difficulty with the countersunk rivet. He found that



Sketch showing rivets in 4 in. × 4 in. centre bulkhead bottom bars in the tank steamer *Meteor*, built by R. Craggs & Sons. In this vessel both countersunk and ordinary common rivets were used, whereas in the construction of the *Fergusons* only countersunk head rivets were employed.

in many cases the pan-headed rivet could not be driven home, on account of the thick neck or taper catching the plate first, while at other times the burr on the plate or flogging up split the head. Variations in the size of the punched holes made it difficult to secure tight fitting in the case of the pan heads, and it was invariably the pan head or weaker end of the rivet which flew off when the strain came. He found that the cone or countersunk rivet was bound to come up to its work and could be plied up from both sides if necessary, making them preferable for oil-tight or water-tight work.

Mr. John Parry, another advocate of countersunk rivets, considered they were better to make tight than the pan heads; they wedged themselves securely all round, and the edges of the head could be "taken in." If the heads were good the pan heads were the best and strongest, and if it was the pan head that flew off he considered the reason was to be found in bad

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workmanship and material. Temperature also had something to do with it, "as" he said, " it is the experience of shipbuilders that rivets can be cut out very much easier when their temperature is a few degrees below freezing-point than when it is at boiling-point."

In those early days Lloyd's preferred the pan-headed rivets, although numerous shipbuilders favoured those of the countersunk-headed type for water-tight or oil-tight work. Messrs. Armstrong, Mitchell & Co., the most experienced builders of oil-carrying vessels, strongly favoured countersunk rivets.

It was during the days when shipbuilders were beginning to see that rivets must not only be tight, but water-tight and oil-tight, that they began to improve the quality of work put into ships of all kinds. Thirty years before Daniel Adamson recognised that boilers must be made to withstand higher pressures, and he partly accomplished this by the introduction of steel as a material of construction. Daniel Adamson and others aimed at turning out an altogether better class of work, and sought to make the boiler as good a piece of mechanical engineering as the engine it was intended to drive. Something of the same thing was necessary in the construction of ships to carry bulk petroleum.

Mr. J. Head, addressing Middlesbrough shipbuilders, said :—

" All engineers know that petroleum is an exceedingly searching and insidious thing. If it be desired to take off from a shaft a crank or wheel which has been there for years, and which has got thoroughly rusted on, it is usual to make a little wall of clay and pour in petroleum which will soon work its way into the joint and act as a lubricant. We know that petroleum will find its way through almost any joint, and it requires a shipbuilder to be very clever to stop it. We know also that some terrible explosions have occurred through the escape of petroleum, and, therefore, it becomes of the utmost importance that vessels intended to contain it should be made absolutely tight, and that means thoroughly good work."

The skin plating in the earlier petroleum steamers was a frequent source of trouble, especially in converted steamers. This was not surprising, considering that the usual method of shipyard construction did not ensure water-tightness, even after the caulker had finished his work. Oxidation was generally relied upon to gradually prevent "weeping" at the butts and lansings. In new steamers, unless of the very highest class, a close inspection of the floors and frames after a few month's service generally disclosed indications of corrosion due to weeping, which, while harmless enough in most vessels, were very objectionable in the case of petroleum steamers. In one or two of the "converted" vessels it was found necessary, to prevent straining and consequent leakage, to put butt straps inside and out. The latter system had the disadvantage that it materially increased the resistance of the vessel. The better plan, and the one generally followed at that time, was the old-fashioned one of overlapping the plates longitudinally. Like many other ideas in shipbuilding and engineering which have been resuscitated and called modern, the system of overlapping butts was well known to engineers and shipbuilders two generations ago.

Petroleum being such a mobile liquid, and one which did not readily combine with other substances, there was always some little leakage in the earliest tank steamers, especially when they loaded refined oil.

During the eighties designers and builders recognised the increasing importance of putting only first-class work into the oil tanks, the subject of rivetting receiving expert attention, and here I may mention that in her day the Palmer-built *Prudentia* was looked upon as a perfect specimen of this kind of specialist work, being absolutely reliable and oil-tight in every single compartment and built on lines which made her a remarkably fine sea boat.

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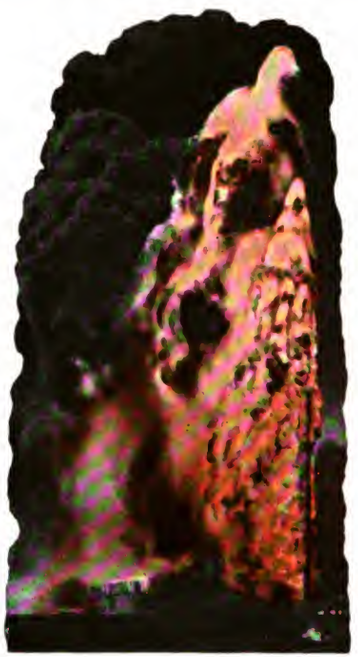

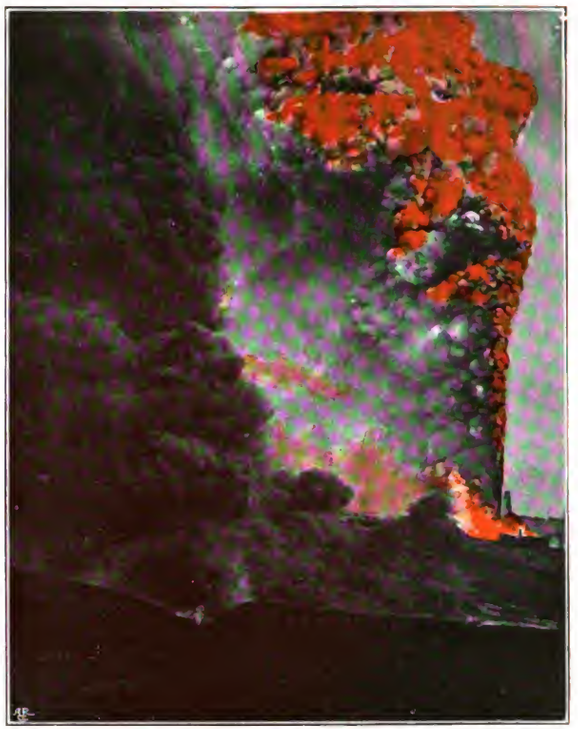

NOTWITHSTANDING the increase of fire-resisting and fire-extinguishing appliances and the employment of steam, chemicals and sand, fire continues to be the much dreaded foe of the oil well driller in all parts of the world. The belching forth of these fountains of liquid fire—the terrible roar of escaping gas, the short, sharp reports, the fierce flashes of blinding light, and the thick clouds of smoke which roll upwards, fold upon fold, and shut out the sky—is a thrilling and appalling spectacle. A spouter

bursts forth too quickly for the workmen to extinguish the surrounding furnaces; a single spark, or a careless act, say, the dropping of a light, and the oil-soaked ground, reservoirs, tanks, derricks and buildings are in a blaze in a moment. In the history of the petroleum industry there are numerous thrilling stories of oil field fires: the most appalling the world has ever known, or probably ever will know, took place at Baku two years ago.
—*The Author, in his work on "Baku."*

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CHAPTER VIII.

The Building of Tank Steamers in the Eighties.

ON July 24th, 1891, at the summer meeting of the thirty-second session of the Institute of Naval Architects—the Right Hon. the Earl of Ravensworth, president, in the chair—Mr. George Eldridge read a paper on the weak points in steamers carrying oil in bulk, and the type which experience up to that time had shown to be most suitable for the trade.*

The great importance to the mercantile marine, and the country in general, of the importation of oil to European ports from the American and Caspian oil fields was not fully realised until attention was drawn to it in the paper read by Mr. Martell before the members of the same institution at the meeting at Liverpool in the year 1886.

Up to that time nearly all the oil sent to Europe from America had been carried in casks and tins, and the expense attending this mode of its conveyance had restricted the quantity imported within very moderate limits. When, however, the great saving of cost was shown in the conveyance of oil in bulk as compared with its carriage in casks and tins a great impetus was given to the trade; and, while at the period referred to only about twelve vessels were employed, in 1891 between seventy and eighty vessels, carrying from 2,000 to 4,000 tons of oil each, were exclusively engaged in the carriage of oil in bulk from America and Baku to various European ports. At that time many alterations had been made in types and sizes of vessels, and sufficient time had elapsed and experience gained to enable a review to be made of the manner in which the vessels performed their work and an opinion to be expressed as to the design best suited for the transport of oil.

In 1872 a contract was made by Messrs. Palmer & Co. (of which firm Mr. Eldridge was then manager) for the building of three steamers† of 2,748 tons gross register each to carry oil in bulk from New York to Europe. Although circumstances arose which diverted the employment of these vessels they were completed and made fit in every respect to engage in this trade if the owners had determined to run them. Mr. Eldridge's interest in the subject of the safe carriage of petroleum in bulk was still further increased by his engagement by the Anglo-American Oil Company to advise in arranging designs and specifications for their first Atlantic bulk oil-carrying steamers. Between that time and the year 1891 he had been employed in surveying more than one-third of the bulk oil-carrying steamers afloat.

In dealing with the points of faulty construction, or inefficient arrangement, he first drew attention to the fitting of the deep keel plate connected to the flat keel plate, the system of construction generally adopted for this description of vessel. This deep plate, instead of being continuous throughout the length of the vessel, was often abutted against the transverse bulkheads and connected by a single angle bar, insufficient in size and held together with rivets which were too small for the strains brought upon them. The result was that the flat keel plate butts, together with the brackets connecting the longitudinal plates and angle bars to which the same were connected, were strained, the butts wasted, and the rivets loose and leaking. This working of the parts was transmitted to the adjacent parts, and in some

* Note to the author (March 25th, 1907):—"Since I read this paper I have built a number of steamers for carrying oil in bulk. In these there has been a modification of the specifications and a number of the arrangements suggested in the paper have been carried out, with the result that all of these vessels are still in the trade, and I am able to say that, from reports occasionally received from the different owners, they are doing their work in a satisfactory manner, with a much reduced expenditure for wear and tear." The paper has been summarised, slightly altered with the consent of Mr. Eldridge, and given in the past tense.

† *Vaderland*, *Switzerland*, and *Nederland*.

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instances extended to a considerable distance. Instead of breaking up the longitudinal vertical plate, it should have been made continuous (avoiding a dependence upon rivets alone), and should either have been lap-butted or have double butt straps, and in either case be treble riveted. In some instances, where this system of construction had been adopted, no working had been found to take place from excessive strain brought on the rigid points where the transverse bulkheads were fitted, and much subsequent repair and additional strengthening were avoided.

When these vessels left a home port in ballast it was customary to fill a portion of the oil compartments with water. In an Atlantic voyage under these conditions, when a vessel was encountering heavy seas, exceptional longitudinal strains were brought on the bottom, thereby rendering it of the greatest importance that, where the continuity of strength was obtained by the method referred to, the utmost care had to be taken to have, in addition to sound workmanship, the brackets sufficiently large and the number and size of rivets well regulated.

Experience showed that of the various methods of connecting the butts of the outside plating none was so effective for ensuring oil-tightness as lap-butting throughout. Many instances occurred where the outside strakes had been lap-butted and the butts of the inside strakes connected by the ordinary single butt straps; the latter proved insufficient for the purpose and it was necessary to fit double butt straps, the expense of which would have been avoided had lap-butting been originally adopted throughout. The fitting of independent tie beams in oil compartments led to very unsatisfactory results. The local straining brought on the ends of the beams almost invariably led to undue stress on the rivets of the beam ends and edge plating in the locality. Local ties of this kind, unless longitudinal brackets were fitted to their ends to disperse the stress brought at this part, caused a tugging on the rivets and leakage. To provide for transverse strength within each compartment no better method was found than to fit substantial web frames from six to eight frame spaces apart; where this was done the structure remained perfectly rigid.

Transverse bulkheads forming the oil compartments were, in many instances, much too light and had to be considerably strengthened. Where leakage took place, or there was considerable rising and falling of the oil or water in the compartments, undue strains were brought on the bulkheads, resulting in panting and the heads and points of the rivets breaking off. Many of the defects found in bulkhead rivets were also due to the slight countersinking, or absence of it altogether, either in the plating or in the stiffening bars. It was not too much to say that, in some instances, where considerable working had taken place, involving great expense for repairs, the initial cause had been attributable to this negligence, and showed the primary importance of sound and careful workmanship in the case of oil-carrying vessels.

The best method of constructing the transverse bulkheads was to fit the plates vertically, with an additional plate above the deep floor plate with lapped edges and butts having a double row of rivets, the edges being arranged to be clear of the vertical stiffening bars so that they could be efficiently caulked. The heads and heels of the stiffening bars and web frames should be secured by substantial knee brackets kept clear of the caulking edge of the bar. The transverse stiffeners or girders should be extended in one length from side to side of the vessel, and not butted against the vertical middle line bulkhead; these should be connected to side stringers with bracket knees not less than 4 ft. long, with treble rivetted joints, and the face angle bars on the girders should be continued around the bracket knee. The absence of continuity of strength led to unsatisfactory results.

In many cases the longitudinal middle line bulkhead had been fitted to very slight scantlings—in fact, the bulkhead had been regarded as a screen only—with the result that they had to be considerably strengthened. This bulkhead should be of a substantial character and practically oil-tight. Its purpose, though not for longitudinal strength, was most necessary in preventing the oil or water from moving from side to side of the vessel when filling or emptying the compartments. It had been the practice with some builders to form holes in this bulkhead, and also in the vertical keel plate, so that the oil might have freedom to move from side to side. This was most objectionable and destroyed the purpose for which the bulkhead was fitted, viz., to prevent the vessel from taking a heavy list, which sometimes happened to a dangerous extent.

The only reason Mr. Eldridge had heard given for perforating the bulkhead was that it made provision for the possibility of a suction pipe in any double oil compartment becoming choked or disabled; but, he pointed out, should such a case occur the oil or water ballast should be pumped out by the adjoining

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suction pipe, and in this way the risk would be infinitely less than that which was incurred by having movable liquid not under control.

If necessary provision could be made for a disabled suction pipe by fitting a plain sluice valve, with rod attached for regulating the same, continued to the upper deck in each oil compartment; this would give control over the liquid in the event of a great inclination of the vessel or a suction pipe becoming defective.

The experience of many captains of oil vessels confirms this conclusion, and in several where openings had been made they were afterwards covered over.

The deck beams in most oil vessels were of angle bars, and, in some cases, to these were fitted short knee-bracket plates connecting them to the vessel's sides. Other vessels, again, had plain welded knees, which in some cases were found to be broken through the welds, and, where not broken, the rivets in many beams had worked loose. This was owing to the inefficient and slight scantlings of the plates, and to reduced thickness in many cases where welding had been adopted, whilst the rivets had been of insufficient diameter. In oil vessels, carrying from 3,000 to 4,000 tons of oil, the rivets should not be less than $\frac{7}{8}$ in. in diameter, with six in each beam arm. In vessels of this size bulb angles or bulb T form should be adopted, even if an iron or steel deck were fitted, and the same should have either the ends turned down or substantial and sufficiently long knee-plates fitted to take the above number and size of rivets.

Except at the ends of the vessel where the oil compartments finished, it was not necessary to have the intermediate transverse bulkheads fitted with a double row of rivets. This double row of rivets, very close to each other, extending around the whole girth of the vessel, greatly increased the risk of leakage, while in such vessels a single row of rivets connecting the bulkheads to the vessel's sides had been found sufficient.

The arrangement of expansion trunks was of considerable importance, and several systems of carrying this out had been adopted.

1st. In spar-decked vessels an advantage had been gained by fitting this trunk continuously throughout the length of the oil compartments; in this way they increased the strength of the vessel longitudinally. On the other hand, this plan caused contracted, dark spaces on each side of the long trunk, and these were difficult to ventilate, unless they were provided with a number of cowls, which were liable to be carried away in boisterous weather. These spare spaces were frequently used for the stowage of reserve bunker coals, but the labour and inconvenience of conveying them to the stokehold in the after part did not commend the arrangement to those who had to navigate the vessel.

2nd. Another arrangement was to fit separate trunks to suit double compartments. This system possessed the advantage of giving a considerable amount of support to the structure above the main deck or tank top while it afforded better light and ventilation between decks. It also enabled the spare bunker coal to be nearer the stokehold, economising labour and time and saving expense in trimming.

3rd. The plan adopted in some oil vessels of fitting expansion trunks on each side of the middle line was open to much objection. It involved considerable danger owing to the difficulty, with small openings, in making a thorough examination of the oil compartments before loading or after the cargo was discharged. This could not be too carefully attended to, and difficulties arose in doing it effectually where small entrances only existed, which necessarily tended to inefficient lighting and ventilation.

Many differences of opinion existed respecting the best form of rivet to ensure oil-tightness. By some eminent builders of this class of vessel, it had been held that no form of rivet was equal to the plug-headed rivet, while others strongly contended that the pan-headed rivet had been found, under all circumstances, to be most efficient for any purpose for which the vessel might be required. A series of experiments were conducted in one of the dockyards for the purpose of ascertaining the relative merits of various descriptions of rivets. Of three kinds which underwent crucial tests—the plug-headed, parallel pan-headed, and pan-headed with swollen necks under the head—the latter description was found to be best for all purposes of ship construction. Experience with oil vessels had likewise shown that the swollen neck pan-headed rivet was not only superior to all others for ensuring strength, but also for oil-tightness. Dispensing with the pan head certainly reduced the weight of the rivet and consequent cost; but in vessels surveyed by Mr. Eldridge he found that the results of the Admiralty experiments held good, and that the least number of defective rivets were those of the latter description.

The pumps should be placed as conveniently near to the boiler as possible, with a view to minimising the condensation of steam in the pipes, which, during

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frosty weather especially, was a source of trouble and loss of efficiency. Several ways had been adopted of leading the suction pipes from the pumps to the oil compartments. In some cases they were laid on the top of the floors at the bottom of the vessel and connected to the transverse bulkheads, with expansion joints in the middle of the compartment. In other cases, they were continued along the main deck on the tank top, with a branch suction into each compartment, the valve rods working from the deck above. Others were fitted inside the expansion trunks, and valve rods for opening or shutting led to the deck above.

The most satisfactory plan was to lay the pipes on the top of the floors with a branch suction to each compartment, and controlled by a valve with rods worked from the upper deck. The efficiency of the pumps was sometimes found to be much interfered with owing to the oil not finding its way readily from one frame space to the other. The limber holes should not be less in area than that of the suction pipe; instead of this the holes were sometimes formed by cutting a small triangular piece off the bottom of the floors where they were connected to the middle line deep keel plate. Where the oil had not ready access to the pumps much delay was caused in draining the bottom of the tanks, while racing and injury to the pumps frequently resulted.

Another important point in connection with the pipe arrangement was to avoid carrying the pipes into any other compartments than those specially intended for oil. It had often been the practice to employ the oil pumps for filling and emptying the foremost deep water ballast tank and fore peak tank with the result that the water passed through the pumps and pipes with a certain amount of oil, and there was an accumulation of gas in the tanks without any means of escape. This was a source of danger it was well to avoid. The oil pumps should only be used for loading and discharging oil, while a separate donkey pump should be fitted forward with suction and filling pipes for the deep water ballast tank and fore peak, and it might, adapted as a fire pump, prove invaluable in a case of fire.

Vessels engaged in the oil-carrying trade were not subject to corrosion to the same extent as vessels engaged in general trade. Oil had a general preservative effect. At the same time, careful attention should be given to parts, such as the main deck, where reserve bunker coals were stowed. In several vessels considerable deterioration took place at this part, extending throughout a length of 50 ft., occasioned apparently by an accumulation of water mixed with small coal and possibly setting up a chemical action.

As to the original intention of designers and owners in fitting double bulkheads on the fore side of the machinery space in the after part of oil-carrying vessels, these spaces were undoubtedly described in the early steamers as water spaces, and the intention was that, when the vessel was filled with oil, these should, for greater safety, be filled with water. Cases occurred where the spaces had not been filled and leakage had taken place, oil finding its way amongst the bunker coals and occasioning considerable danger. Had the space been filled with water this could not have occurred, as the oil would have floated on the surface and could easily have been removed. The space was sometimes made only one frame, or about 2 ft., between the bulkheads, and left badly ventilated; and cases were known where a sea-cock and oil suction pipe had been fitted in this space. It was evidently very difficult for a man to find his way into this space to effect repairs or clean it out, and, doubtless, this was why it was found to be the most dirty and neglected part in the earliest of the oil vessels. These spaces should not be less than two frame spaces, or about 4 ft., fore and aft, and should be kept clean and frequently visited. Owners should issue distinct instructions—as many at that time did—that when the vessel was oil-laden the water space should be filled with water as originally intended.

The question of clearing the oil compartments of gas when men had to enter them for examination or repairs was one of vast importance. It had been the practice with some owners to fill the tanks to overflowing, skimming off the oil as it rose to the surface, and then pumping out the water. Although this was doubtless the most effectual means of freeing the compartments of oil and gas, experience showed that it was unsatisfactory in a case where men might find it necessary to enter the tanks some time after this had been done. There were so many interstices in the inside of a vessel that merely filling the hold with water would not eliminate all risks of accident; precautions were necessary after this had been done as evaporation from heat of the small remaining portions went on and explosive gas was produced. A number of rivets should be driven out of the bottom for the escape of the gas, and there should also be wind-sails in every compartment. Early experience showed the necessity of going beyond this, and, instead of disturbing the rivets, three plug-holes, about 1½ in. in diameter, should be formed in each oil compartment,

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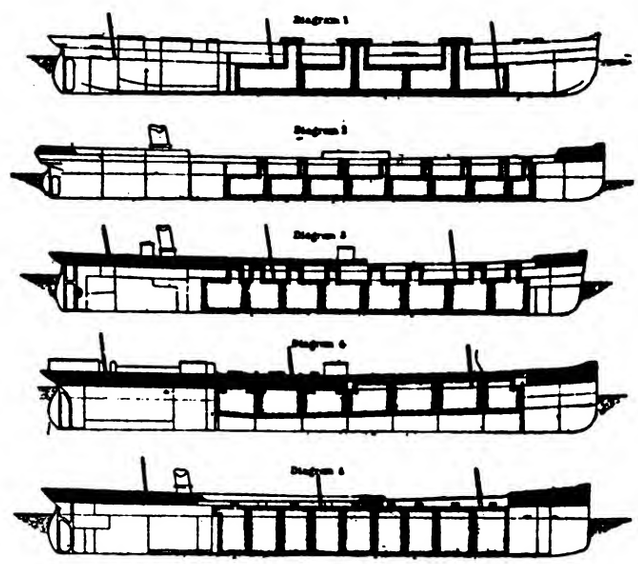
and these, with windsails and the open hatches, would effectually keep the holds free from gas. No practical difficulty prevented the effective closing of these holes with plugs, which could be removed as necessity arose, and much of the danger which existed in visiting the holds of these earlier vessels would be obviated.

Notwithstanding the dissatisfaction expressed by many interested respecting the performances of some steamers engaged in carrying oil in bulk, the causes which gave rise to the dissatisfaction were not far to seek. When, in 1885 and 1887, the great impetus was given to building vessels for carrying oil in bulk very little was known of the risks of damage to these vessels. The permeating qualities of petroleum were known, and experts were aware that small vessels had been successfully engaged for years in carrying oil in bulk on the inland seas and rivers in Russia. This, however, gave very little indication of the requirements of strength and local arrangements for vessels intended to cross the Atlantic in winter seasons. Consequently, it was felt that if vessels were built of equivalent strength to those which had satisfactorily carried cargoes of varying densities, and, in many instances, indifferently stowed, the fact of the transverse strength being greatly increased by a large number of bulkheads in oil-carrying vessels, and the cargo being of a homogeneous nature, should add still further to their safety. Something more than this, however, was necessary to enable them to cross the Atlantic satisfactorily when fully laden with oil. Although the additional bulkheads increased their transverse strength, the necessity of making them water-tight broke up the continuity of strength attained by the stringers, keelsons, etc., extending, as in ordinary vessels, all fore and aft. These longitudinal connections had to be discontinued at the bulkheads and attached by brackets. The imperfect manner in which this was done, in many instances—the brackets being deficient in size, and the rivets too small and few in number—doubtless led to the inefficiency of some of these vessels when they encountered heavy gales. Added to this was the inexperience of many of the captains. In some instances, when vessels were thought to be unduly light and too tender, one or more of the compartments were run up in mid-ocean, and the effect of this large volume of moving water in straining the vessel can be easily imagined. Again, some were too deeply laden when crossing the Atlantic in mid-winter, and undue straining resulted from this cause. It was not a question of additional scantlings, but more a question of *local* connection and sound workmanship. In fact, the rivetting should be arranged as for boiler work and be equally well done.

"It is thought with the experience now acquired as to the best type of vessel for the work, and the arrangement of materials and quality of rivetting and workmanship necessary for this exceptional trade, that the great expense, inconvenience and dissatisfaction caused, will be obviated in the future; and that while oil-carrying vessels are the safest as regards collisions, they will, if the experience gained is properly utilised, be found to be equally successful when compared with other types in meeting the worst descriptions of weather." This was the opinion expressed by Mr. Eldridge at the end of his paper, and it is scarcely necessary to point out how abundantly the tank steamer of to-day has proved that his prognostications in 1891 were correct.



These designs (drawn by Mr. Eldridge) show types engaged in the oil trade fifteen years ago. Some of them are running to-day. For description see text.

No. 1. This vessel, 2,748 tons, was constructed with two skins about 26 in. apart, and the main hold to the height of the lower deck was divided into ten separate compartments. A great rise of floor of about 3 ft. 6 in. was adopted to raise the centre of gravity of the oil and cargo, and thereby reduce the initial stability. Early experience showed that by adopting the principle of having empty spaces between the outside skin of the vessel and the oil tanks much danger was incurred from the facility thus afforded for gas accumulation. In later designs this system was abandoned.

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No. 2. Shows another design of a spar-deck steamer built for this trade. This vessel had a short poop, forecastle, and midship deckhouse, not extended to the sides of the vessel. Each oil compartment had an expansion trunk 5 ft. by 3 ft. placed at the fore end, fitted between decks, extended 3 ft. above the spar deck and closed at the top with an air-tight lid. A short poop or hood is shown fitted at the stern, but experience gained in the Atlantic trade showed this to be of small benefit in protecting the vessel from following seas, and preventing an inundation of the engine room at the after part of the vessel.

No. 3. This is a three-decked vessel with full scantlings and a comparatively small freeboard, having a topgallant forecastle, a poop extending from the stern as far forward as the after expansion tank, with accommodation for the officers, etc., and a short poop bridgehouse amidships. Above the upper deck a hatch 12 ft. by 8 ft., with coamings 3 ft. in height, is fitted, in continuation of the expansion trunks of each compartment. These hatchways are fitted with a plate-iron cover, secured by nut and screw bolts to form the top of the expansion tanks, and have two oval manholes to give access to the tanks. To this system of fitting the covers of the expansion tanks there are great objections; they do not admit of the hatches being readily opened for repairs, and when the crew are engaged in preparing for cargo the tanks are almost in darkness, thus necessitating the use of artificial light at all times. After this type of vessel had been engaged in the Atlantic trade for some time it was found necessary, in order to prevent green seas flowing over the part of the deck between poop and bridge, to fill in this space by a shelter deck and enclose the front of the bridge by an iron bulkhead.

No. 4. This represents a vessel with one deck laid, having a topgallant forecastle for the crew, and a long poop extending from the stern to about 180 ft. forward. Below the poop-deck are three cylindrical expansion trunks, with hatchways on the deck for entering the same. Before the poop, over the remaining compartment, is fitted a continuous expansion trunk, 4 ft. 6 in. high and 18 ft. in width, with hatchways over each compartment, 6 ft. by 4 ft., all fitted with air-tight covers. In this type the upper deck forms the top of the oil tank. It was found, owing to the low freeboard at which this and similar vessels were sailed, that the well forward was constantly flooded, even in a moderate sea in the Atlantic, and it was consequently decided to fill in the space between the poop and forecastle as indicated by the ticked line, thus forming a continuous superstructure fore and aft. This vessel had a patent double bottom, which did not prove satisfactory, and, although originally intended to be an empty space when the vessel was filled with cargo, it was afterwards employed as a cargo space. Experience, however, showed that such confined and dark spaces were extremely dangerous in vessels used for carrying petroleum in bulk, as they were liable at times to become filled with gas from the oil.

No. 5. A spar-decked vessel, having a topgallant forecastle, short midship deckhouse, and a long poop covering the officers' accommodation, engine and boiler casings, and stokeholds, and with high coamings around all the openings on the poop deck, thus preventing water readily finding its way below, as is generally the case where vessels are fitted only with casings about 7 ft. high above the deck.

As an instance of this, Mr. Eldridge was once informed by a chief engineer of a vessel of this type that, during the heavy gales of January, 1890, it took the second engineer and a fireman over two hours to secure the covering over the air hatch to the stokehold, whilst he remained below in charge of the engines; and that, with all the pumps going, the water rose to 2 ft. above the stokehold floor before the covers were securely fixed. The engineer stated that if any derangement of the pumps had occurred the vessel would undoubtedly have foundered. With engines aft it was absolutely necessary in the steamers of that year (1890) to fit a poop at least of sufficient length to cover the whole of the machinery space. Although this vessel had a freeboard considerably in excess of vessels of the type shown in Diagram 3, still a large quantity of water found its way at times on to the deck between the poop and bridge. It was seen that it would greatly increase her safety and comfort if the poop were continued to the bridge, and also that a vessel of this improved type would be most satisfactory for the North Atlantic trade, especially during the winter months.

A Tyneside authority,* who has dealt with some of the earlier problems of tank steamer building, says:—

"The tanks must be large enough to contain the required quantity of oil at the rate of 44 to 45 c. ft. per ton, with 2 per cent. added to this for expansion.

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* Mr. H Böcler.

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American oil requires from 44½ to 45 c. ft. per ton; Russian oil about 43½ c. ft. per ton. An allowance of 2 per cent. for expansion provides for an increase of about 40° in the temperature of the oil, without bringing extra pressure upon the tanks. Double bulkheads, about 4 ft. apart, forming a cofferdam, are placed at each end of the oil space to prevent leakage into the adjacent compartments."

This is a theory of early days. When tank steamers first started, the question of the size of the tanks was easily arranged, as the only oils then carried were American refined and crude and Russian refined. Although there is a considerable difference between the gravities (American refined and crude having a sp. gr. 795 to sp. gr. 800, and Russian refined ·820 to ·825), yet, owing to the geographical situation of the loading ports, the difficulty practically solved itself. With American oil the steamers had to take about 10 to 12 per cent. of their dead-weight capacity as bunkers for the passage from the United States to Europe, while with Russian oil they took their bunker coal about half-way between the Black Sea port and Europe, so that the quantity of bunkers required was only 5 to 6 per cent. of the dead-weight capacity, which equalised the difference in the weight of the cargo.

Later, as the trade grew and became more complex, and the tank system extended, gas oil, lubricating oil, residuum and benzine were carried, with gravities varying from ·680 to ·910, and this complicated the arrangement of the tanks; because to obtain the best results, from a financial point of view, it is necessary that while a steamer should carry her full dead-weight capacity of benzine, she should also have some of her tanks completely full when loaded with a cargo of the heaviest oils.

The same authority (Mr. H. Böcler) says:—

"The best position for the engines and boilers is aft, for if the machinery is placed amidships two extra cofferdams are required, and the shaft tunnel has to be made oil-tight through the after tanks."*

This unqualified support of a position aft is scarcely justified to-day, when we have such steamers as the *Caucasian*, *Narragansett*, *Tuscarora*, *Phœbus*, and many others, proving in actual practice that there are advantages in placing the engines amidships. When tank steamers were about 300 ft. in length, it was not a disadvantage to have the engines aft; but now when the latest vessels carry three times as much cargo as those launched fifteen years ago, a certain risk of straining is run in the case of a vessel with her engines and boilers aft, and never more so than when she is steaming in ballast in heavy weather.

The largest of the Shell liners—indeed the entire fleet—have their engines aft, and nothing in the experience of the owners has led them to make a change. I must also admit that the advocates of this type might with very good reason point to the huge coal-carriers on the American lakes as evidence in support of their contentions, but here it must be remembered that there is no comparison between the size of the seas in the lakes and those encountered in the ocean.

The expense of placing the engines amidships is a little greater, owing to the oil-tight tunnelling required under the after tanks, but owners of vessels with engines amidships get compensating advantages in a vessel which is stronger and easier to handle. Some who advocate a position aft make a strong point of the possibility of sparks from the smokestack amidships falling on the oil space aft of the engine room, and declare that it reduces to a minimum the risk of oil reaching the fires or bunkers. In actual practice it seldom occurs that sparks reach the deck; when a vessel is steaming there is generally sufficient wind to keep her clear of these smokestack dangers.

When the engines are amidships a steamer can be more easily trimmed, and, no matter whether she burns coal or liquid fuel, she can be kept on a more even keel, will steam faster, and burn less fuel.

The Middlesbrough school, deeply interested in the early problems of tank steamer construction, devoted a great deal of attention to the position of the engines. Mr. T. Westgarth supported the idea that it was better, even in comparatively small steamers of that time, to place the engines amidships. With the engines amidships he considered they avoided trouble and expense in trimming coal, "because with engines aft coal was carried along the 'tween decks and even in the fore-hold." Again, when a vessel with the engines aft was light, she had to be kept on an even keel by filling one or more ballast or oil tanks with water; this probably caused very severe strains upon the hull in a sea-way, especially when the vessel was water-borne amidships.

Mr. E. H. Craggs, whose firm arranged the *Fergusons* and the *Caroline Robert de Massey* and

* Messrs. Craig, Taylor & Co. claim that they were the first to build an oil-carrying steamer with engines amidships.

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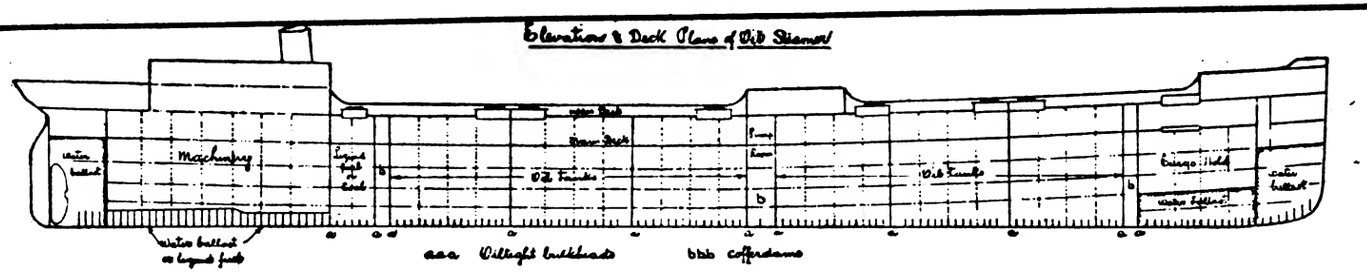

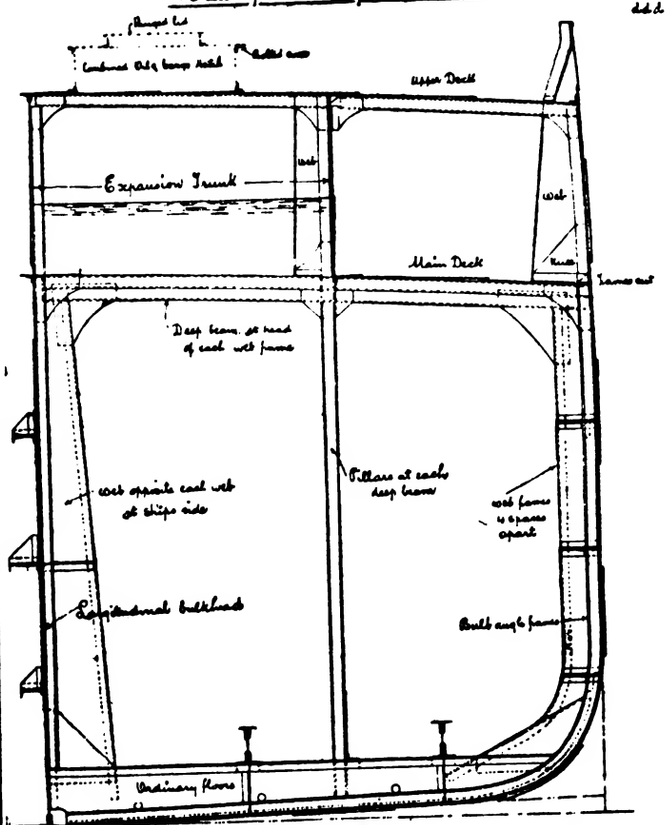

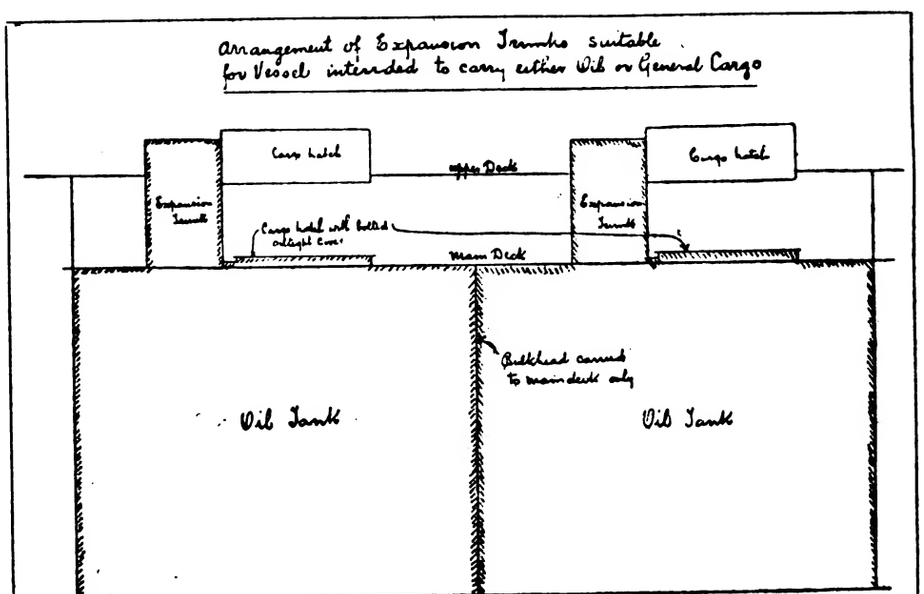

These important original sections, (drawn by Mr. H. Böcler, A.M.I.N.A., and reproduced by permission of Mr. A. G. Hood, of the *Shipbuilder*, Newcastle) explain themselves.

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built the *Mexicano*,* one of the first specially designed tank steamers with engines amidships, was a pioneer advocate of this position. He considered that, structurally, amidships was the best position, and experience led him to express the opinion that it was most necessary to have them there in cases where trimming a ship on an even keel with part cargo or in ballast was desirable.

When the engines are amidships the cofferdam arrangements are more perfect. It has been found in practice that a steamer with two or three cofferdams for separating different kinds of oil is stronger and does not strain so much as one which has no cofferdams.

Mr. Böcler has supplied the following information:—

"When the machinery is situated aft, it will be found necessary to place the forward bulkhead of the oil tanks a considerable distance aft of the collision bulkheads, in order that the steamer may not trim by the head when she is laden with oil and her bunkers are burned out. A vessel large enough to carry a certain dead weight of oil possesses a carrying capacity in excess of the cargo loaded, and there is, therefore, a certain amount of surplus capacity which can be left where most desirable. The usual practice is to carry the oil below a second deck, except in the 'tween decks, as the oil is then more protected from changes in the temperature of the atmosphere. The balance of the surplus capacity is made up by the contents of the fore-hold, which is fitted to secure a satisfactory arrival trim. The size of the individual tanks is governed by considerations of strength and stability, and by the necessity of limiting the quantity of oil which would run out in the event of a tank being damaged. In the case of a steamer carrying about 6,000 tons of oil, the tanks would be formed by transverse bulkheads about 32 ft. apart, combined with a central oil-tight division throughout their range. The total number of tanks would be twelve, each having a capacity for about 500 tons of oil.

"Some empty spaces must be left in the tanks to allow for the expansion of the oil, and at the same time it is very important that the free surface of the liquid should be limited in extent. In order to fulfil these conditions, expansion trunks are fitted. The form of trunk most commonly met with consists of a central trunk fitted in the 'tween decks for the full length of the oil space, having transverse divisions corresponding to the bulkheads below. In the case of vessels intended to frequently carry general cargoes instead of oil, a more expensive system is adopted in order that the 'tween decks may be easily accessible. Small trunks are fitted to each tank, combined with an arrangement of hatchways with bolted iron covers. The relative capacity of the trunk and tank must be such that the minimum level of the oil will not be likely to come below the bottom of the trunk when the vessel rolls. The critical conditions for stability in a well-designed vessel do not occur when she is fully laden, as then the free surface of oil is limited in extent. While loading and discharging, however, the free surface will extend right across the tank, and care must be taken not to have several tanks partially empty at the same time. When the centre bulkhead is oil-tight, the loss of metacentric height due to the free surface is only one-fourth of what it would be if this were not the case. The system of construction usually adopted in the tanks is to fit web frames and deep beams about four spaces apart; the deep beams being supported by channel pillars. The intermediate frames are of bulb-angle section, and ordinary floor plates extend from the centre bulkhead to the bilges. The frames are cut at the oil-tight deck, the strength being maintained by fitting large bracket knees. The bulkheads must be heavily stiffened, as they have to withstand very severe stresses. Lloyd's rules require that each tank shall be tested with a head of water 12 ft. above its crown. The horizontal stiffeners on the transverse and longitudinal bulkheads are kept in line with the side stringers, and large knees connect them at the corners of the tank. The main stresses due to the oil cargo are borne by the rivets connecting the frames to the shell plating, and not by the floors and frames as in the case of an ordinary cargo vessel. For this reason, and also owing to the penetrating nature of the oil, it has been found necessary to space the riveting closer in oil work than in ordinary practice. The spacing which has been found suitable for the butts and seams of shell plating is three diameters from centre to centre. This spacing is also adopted in bulkheads and decks where both seams and butts are double riveted, while the rivets through the frames and outside plating are spaced six diameters from centre to centre. It is essential for the successful working of a tank steamer that means should be provided for the rapid discharge of cargo; hence a special pumping installation is introduced, consisting

* This steamer was specially designed to meet the objections of some American underwriters.

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generally of two pumps, with the necessary piping, having sufficient power to discharge the cargo in about thirty-six hours.* The best position for the pump room is amidships, as the distance the oil has to be pumped is reduced to a minimum. The main pipe lines are laid on top of the floor, one at each side of the centre bulkhead. From the main pipe line, branch sections are led to each tank, controlled by valves worked from the upper deck. The delivery pipes are so arranged that the oil may be discharged from either side or over the stern. The pumps are arranged to empty the tanks and to fill them with water, but they are not usually arranged to pump oil on board,† and are shut off by valves from the pipe lines while the tanks are being filled from the shore. The practice of filling the tanks through the hatches has been largely discontinued, as too much vapour is given off when loading in this way. A cofferdam is fitted below the pump room from the sea suctions to the pumps, as these should on no account pass through the oil tanks. Twenty years ago the objection was urged by shipowners that a petroleum vessel could not be used for any other cargo. Gradually experience showed that they could be most usefully employed in ordinary trades. Of course, all traces of petroleum had to be eliminated. This was done, in the first place, by careful scrubbing down of the holds, beams, etc., using a jet of water under pressure, and finally a jet of high pressure steam. If all traces of oil were not then dissipated, a coat of lime effectually rendered the tanks sweet. It was not supposed that the vessel would be employed in the tea or coffee trade ; but, as one authority put it, if used for coals or wood or ore for the first voyage, and then cleaned out thoroughly, the vessel could with safety carry sugar, coffee and fine goods."

To-day the oil-stained tanks are cleaned by means of steam injection in such a manner that the steamers are able to load such delicate cargoes as tea and sugar, and, as recently as February this year, the tank steamer *Santa Rita* discharged a cargo of eight hundred pianos at San Francisco.

Before I finish on this subject I should like to say that, amongst the many practical men who are to-day devoting attention to the problems of ship construction is Mr. Isherwood, for many years a Lloyd's surveyor. He has arranged a new system of framing for an oil-carrying vessel ; it is one in which the numerous transverse bulkheads form the oil tanks, and its adoption in the case of a new tank steamer would be a matter of great interest from the naval architect's point of view.

* The *Narragansett* generally discharges her 12,000 tons of oil, bunkers, and sails again in forty-eight hours, while some of the smaller tank steamers can discharge and get away to sea again well inside twenty-four hours.

† There is a slight error here. The majority of the tank steamers of to-day have a pumping equipment to load oil. On the Danube where part cargo is brought down from Braila to Salina in tank barges, the tank steamers pump the barges out without any assistance.

"From the arched roof,
Pendent by subtle magic, many a row
Of starry lamps and blazing cressets, fed
With naphtha and asphaltus, yielded light
As from a sky."

MILTON in "Paradise Lost"
(*The account of the lighting of Pandæmonium*).

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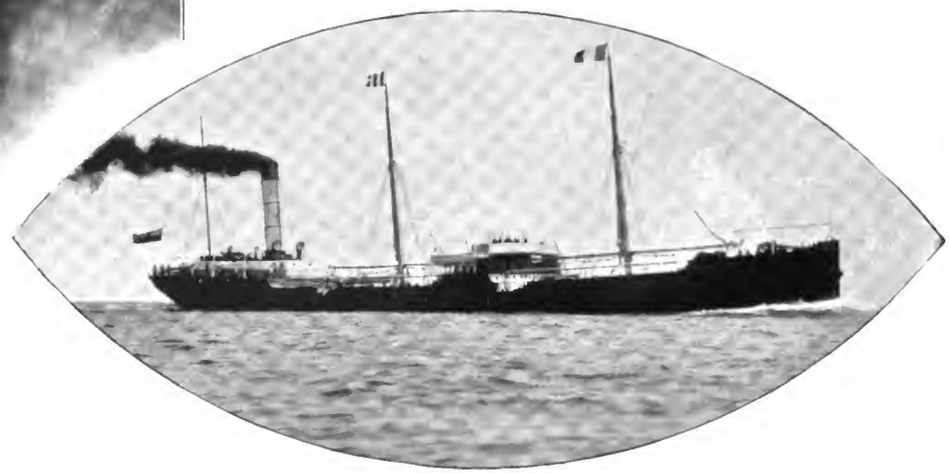
MESSRS. LANE AND MACANDREW'S STEAMERS
Luciline and *Le Coq*.



Those who command this company's steamers are—

Caucasian :—
Captain BROWN.

Luciline :—
Captain HELSHAM.

Oriflamme :—
Captain FOSTER.

Le Coq :—
Captain PETERSON.

Euplectela :—
Captain DAVIES.

Terek :—
Capt. CALLAGHAN.

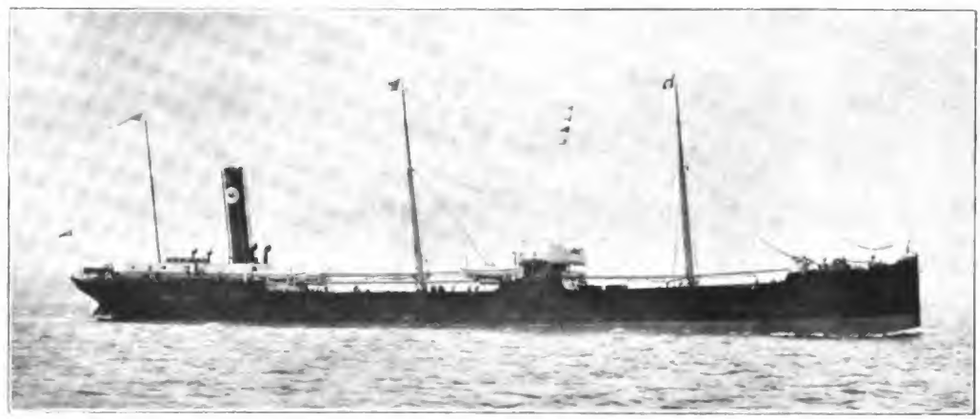
Pinna :—
Captain FAIRFIELD.

Recklight :—
Captain PARRY.

Balakhani :—
Captain CLARIDGE.

Lux :—
Captain GREEY.

One of the pictures on this page show how the French three-masted schooner *Bois-Rose* was lost at sea. She was bound out from Fecamp to the Grand Banks, when she encountered a succession of severe gales and became water-logged. The *Luciline* took off the crew just before she foundered. The *Luciline* was commanded by Captain Helsham, and Mr. S. D. Reddie, chief officer, had charge of the boats which rescued the crew.



The *Le Coq*.

[*To face p. 71.*

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CHAPTER IX.

Tank Steamers of the Last Seven Years' Trade in the Far East and between California and the Orient, and the Oil-carrying Barge Systems of the World.

THE descriptions in earlier chapters of what has been accomplished by the largest oil distributing and tank steamer-owning companies and those devoted to the construction of tank steamers bring this history practically up to the present year. In these, however, it will have been noticed that I have not referred to the steamers of a number of independent companies, particularly those of the Prince Line and Burmah Oil Company, which have vessels engaged in the trade. I have only space for brief references to the successful Scotch company which has oil properties in Burmah, one or two English-owned steamers, and the typical modern tankers *Phœbus* and *Petroleum*, the first owned at Hamburg and the last named by the British Admiralty.

The sister ships *Syriam* and *Kokine* were built to the order of the Burmah Oil Company, Rangoon, by the Grangemouth Dockyard Company, for the Indian trade, in 1899. They embody a number of interesting features. While the larger proportion of the cargoes consists of bulk oil carried in eight oil compartments, having oil-tight centre bulkheads extending the whole length, provision is made for dealing with a considerable proportion of oil in cases or general cargo. For this purpose the oil compartments and 'tween decks alongside the expansion trunks are fitted with portable ceiling and sparring, the latter having the necessary side hatches.

The hatches giving access to the holds are so constructed that when the vessels carry general cargo the usual oil-tight hatch covers are removed and the whole width of the hatch made available. Each hatchway is provided with a derrick and powerful steam winch.

The machinery for dealing with the oil include two Snow pumps, each capable of discharging 180 tons per hour, and these operate through a double line of pipes controlled by an elaborate arrangement of valves whereby either or both pumps can deal with each compartment, pump from one compartment to another, and draw from, and discharge into, the sea or overboard. If required, the oil compartments can be cleared of vapour, or, in the case of fire, the flames extinguished, by steam being admitted to each or all of the compartments through the pipe lines. A powerful air fan, by the Stirtevant Company, can be brought into requisition for exhausting the dangerous petroleum gases from the tanks, and for the detection of the presence of gases Redwood's patent detecting instruments are provided. The whole of the valves for manipulating the pumps, sea suction and discharge, air fan and steaming out valves, are controlled from the pump room. The valves at the bottom of each compartment and the end master valves are actuated by rods extending to the spar deck. Electric light is supplied by a direct-driven dynamo in the after part of the engine room, the wiring being on the double wire system, armoured cables. Electricity is used for masthead, side and anchor lamps, and portable hand and accumulator lamps are provided for holds and store rooms.

The *Bloomfield*, built by the Tyne Iron Shipbuilding Company, Ltd., in 1899, for Messrs. Hunting & Son, Newcastle, is 350 ft. by 50 ft. by 31 ft., and is divided into thirty-two separate oil-tight compartments, with six separate water-tight compartments, besides her machinery space, cross bunker, cargo hold and pump room. She has a double installation of powerful pumping machinery, a ventilating fan for exhausting air in the oil-tight compartments, electric lighting throughout, steam winches, direct-acting steam capstans, direct-acting windlass with capstans, powerful steam steering gear, and steam heating throughout.

When the 'nineties were entered, and Texas was booming, many large steamers were built. Some of the most important were for the Anglo-American

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and Shell companies and are referred to in the chapters especially devoted to them. In 1902 the Deutsch-Amerik. Petro. Gesell., of Hamburg, gave an order to Messrs. Dunlop & Co. for the *Phœbus*, one of the most useful steamers running in the European-American oil trade. Her tonnage and some interesting particulars are given on one of the plates. The hull is divided transversely by bulkheads, forming four cofferdams and eight main oil tanks, these tanks being again divided longitudinally by a fore and aft bulkhead extending right through and continued into the hatchways to the shelter deck. Her cofferdams are most perfectly arranged; they are not only strongly built, but are scientifically arranged to reduce the risks of leakage and explosion to as near disappearing point as possible. The shaft tunnel, extending from the engine room to the after part of the steamer, and absolutely oil and water-tight, is of circular form, access being through a trunk leading from the shelter deck as no accommodation is allowable from this part of the vessel to the engine room, owing to the danger that might arise from leakage of oil or gas. A large proportion of the internal work on this steamer was done by pneumatic rivetting, while the whole of the caulking, both in the shell and tanks, was done by pneumatic tools.

The pumping appliances consist of four duplex Snow pumps of special design and construction, a large and small pump being placed in each of the pump rooms forward and aft of the steamer, the total capacity of the pumps being equal to loading or discharging a full cargo in twelve hours.

The photo shows that she is lightly rigged as a fore and aft two-masted schooner, with a derrick on each mast, and steam winches for handling light cargo or barrels. A complete system of ventilation is provided and where either oil or gas accumulates two large fans, one in each of the pump rooms, are fitted.

The *Cymbeline*, built in 1902 for the Bear Creek Oil and Shipping Company, Liverpool, by Armstrong, Whitworth & Co., Ltd., carries her cargo in six separate compartments, formed by intermediate water-tight transverse bulkheads. The centre line longitudinal water-tight bulkhead is carried for the full length of the compartments to the height of the main deck. She has a complete installation of pumps and pipes for dealing with the liquid cargo, steam windlass, steam winches, steam steering gear, and is fitted throughout with electric light.

Another important tank steamer is known as the *Petroleum*. She was purchased by the Admiralty for the carriage of oil fuel for His Majesty's ships. The use of petroleum as a steam-raiser having now passed the experimental stage, an increasing number of warships are being fitted for burning it. This steamer is available both for the transport of oil to the various naval depôts and for supplying the warships with liquid fuel at sea, a process which is carried out by taking the tank steamer in tow and connecting the two vessels by a second hawser, from which is suspended a line of hose through which the oil is pumped from the tanker into the bunkers of the battleship. The *Petroleum*, built by Messrs. Swan, Hunter & Wigham Richardson, of Wallsend, carries about 6,000 tons of oil.

With the exception of the important reference I make later on (*see* Chapter xiv.) to vessels which are being built at the present time, this finishes what I have to say on the subject of the leading features of British tank steamers. Before concluding this chapter I must refer to several special trades in which a number of tank steamers and thousands of barges and small craft are employed.

A steadily increasing business in oil, and one concerning which very little is known, is carried on between America and the Far East. It was inaugurated by sailing vessels, and to-day the largest bulk and case oil sailing ships in the world, owned by the Standard Oil Company, sail regularly for India, China and Japan.

It is some years since (1899) the British-owned tank steamer *Robert Dickinson* (Capt. McDonnell) loaded American oil for the Far East, and it was then thought that steamers of her class would run the sailers out of the trade with the Orient.* It was considered that she secured advantages over the sailing vessels by making the passage *viâ* the Suez Canal. There was nothing revolutionary in this trip, and the sailing ships of America continue to prove the futility of the experiment. At any rate, during a

* When the first tank steamer arrived in China, the curiosity of the native labourers was very much aroused when they were told that her cargo of 1,500,000 gallons of oil would be discharged in forty-eight hours. Thousands of Chinese gathered along the wharf where the steamer lay, and astonishment of the most intense description was depicted upon their usually phlegmatic faces. The ship rapidly rose out of the water as the oil was pumped ashore through the pipes. The wharf manager, accosting a Chinaman, asked him what he thought of it. "Well," said the Chinaman, "I can't make it out at all. Nobody pushes; nobody pulls; but the cargo is discharged like mad all the same."

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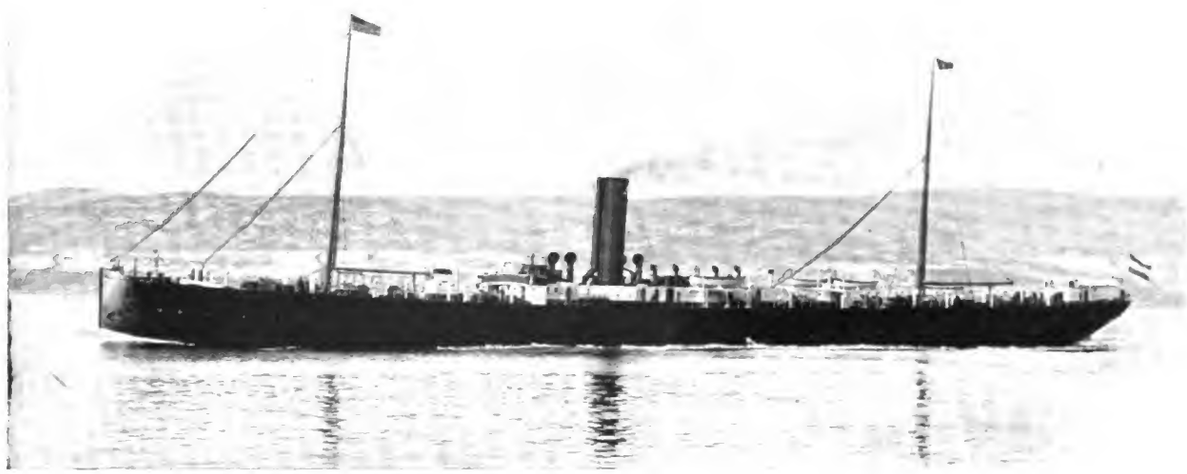


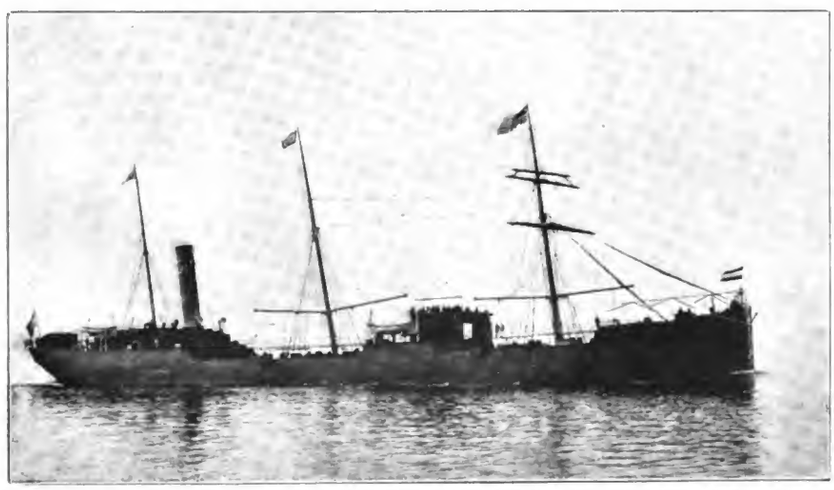
THE PHŒBUS.

THE *Phœbus* was built by Messrs. David J. Dunlop & Co. for Messrs. Riedemann (Deutsch Amerikanische Petroleum Gesellschaft), of Hamburg. She has a deadweight carrying capacity of 8,150 tons on 26 ft. This steamer has been running with American oil to a German port, and it is interesting to notice that she has carried on an average 1,250 tons more than would have been permitted had she been discharging her cargo in a British port, and this without any damage or loss. A description of this successful steamer appears in the text.

With the exception of the *Chesapeake* and *Phœbus*, which have their engines amidships, the other steamers built by this company have their engines aft. The midship arrangement has been proved to be less severe on the hulls than with the engines placed aft; this is largely due to the vibration caused by the machinery when it is placed aft, more especially in the case of large vessels in ballast trim.

As I state in the text, this company also built the *Manhattan* for the Anglo-American Oil Company in 1889. She carried a deadweight of 4,265 tons on 22 ft. mean draft. Since that date they built the *Delaware Lackawanna* for the same company.

In the *Delaware*, built in 1893, they placed all the transverse girders and vertical stiffeners on one side of the bulkhead, leaving the other side entirely free for the caulking of the rim bars and landings, and the making tight of any defective rivets. This has been found to be a great advantage over the bulkheads which have their girders on the one side and stiffeners on the other, as this arrangement makes it difficult to trace the source of any leak.



THE HELIOS.

They built the *Aco* in 1894, for the American Cotton Oil Company, to carry 4,800 tons on 23 ft. 4in. of refined cotton seed oil—a most valuable cargo. This the vessel continued to do for some years, but later she was transformed into a petroleum-carrying steamer (*Helios*). They also built the *Osceola* in 1897, for the Anglo-American, to carry 380 tons on 10 ft. draft, for the distribution of oil to the depôts in Ireland and the South of England.

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single month in 1901, when the exports for the East broke all records, no less than sixteen sailers and one steamer, the case oil-carrier *Palgrave*, were chartered at New York to carry oil to Japan. Of this fleet nine were full rigged ships and six barques, and they carried no less than a million-and-a-half cases of oil. The Standard Oil Company runs several large case oil steamers, including the *Kennebec*, built on the Clyde, in this trade.

Formerly oil-carrying steamers returned from the Orient in ballast, but experiments have shown that general cargoes can be carried on the return journey, so that now practically all the tank steamers bring back Oriental cargo.

It is some five years since the first of a fleet of French sailing vessels left Philadelphia with oil for Japan. They were the result of a boom in French shipbuilding caused by the granting of a Government bounty. Their French owners sent some full rigged ships to the United States to compete for the trade to the Far East, then, and still, a monoply of American and English sailing vessels. As showing the advantages of this bounty system in the case of French sailing vessels it may be mentioned that one of these case oil carriers earned 12,750 francs for merely crossing to Philadelphia light. They receive a certain sum for every thousand miles covered.

Some of the companies have met with great difficulties in their attempts to popularise petroleum in China, and the Russo-Japanese war did not improve matters, certainly not in the case of the Shell Transport and Trading Company, whose Borneo oil fields, by the way, are only six days from China and ten days from Japan. China has not reached a state of material well-being that makes oil an essential article of household use, and the millions of poor people of this great Empire, having no knowledge whatever of the advantages of mineral oil, are quite content with home produced vegetable products.

The growth of the oil industry of California is one of the greatest industrial romances of America. Ten years ago the coastal petroleum trade of the Pacific was in its infancy; to-day it is one of considerable magnitude, and California is the chief producing State in America.

British-owned tank steamers were employed in the inauguration of this trade on the Peruvian coast. The *Bakuin* was sent out to run on the Pacific coast under charter to the London and Pacific Petroleum Company, and when she was destroyed by fire the *Azov* and *Circassian Prince* were placed in the Pacific oil trade. Some years before these steamers traded to San Francisco and other ports, barges and small sailers were employed transporting oil both on the Peruvian and Californian coasts.

Then came the boom days of Coalinga, followed by those of Santa Maria Valley and half-a-dozen other great oil fields, which have swelled the production of California and placed it at the top of the list of producing States. The discovery of one petroliferous tract after another created a huge trade in liquid fuel, led to the employment of a number of tank steamers, and started a promising and profitable trade with the Far East with all that means in the shape of fuel contracts with Japan.

The Standard has done a great deal for California oil. It has organised one of the greatest pipe line systems in the world, and done everything possible to foster the starting of individual enterprises likely to increase the production of the different oil territories as they have been discovered. The Union Oil Company, well managed and enterprising, has also assisted to build up the industry, not only by producing oil but by running a fleet of oil-carrying vessels and working an extensive system of pipe lines, its greatest undertaking in that direction being the laying of the pipe line across the Isthmus of Panama for the purpose of sending California oil to ports on the Eastern coast, and also, it is said, to Europe.

Take the world's petroleum business in all its numerous branches, not even omitting the one of a professional study of the extraordinary elements which constitute oil field life in a new gusher region, and I do not know where you will find anyone to equal Mr. C. T. Lufkin in the making of a rapid and correct estimate of men, their methods and discoveries. There are few acres of this vast oil world which he has not examined. I have met him in Texas and followed in his tracks through the Carpathians, and I know that his reputation as an expert is one of which any man might well be proud. He has gone before the Standard in more than one country. I recall the fact that his forecast in regard to the life of the Spindle Top field came true; there was almost total stoppage of production within three years, and it was he who first foresaw those openings which now exist for the sale of huge quantities of California oil in the Far East.

"There will be a great market for California oil in Japan and the Orient," he prophesied.

Mr. Lufkin, some five years ago, talking about the market for California oil in the Far East, pointed

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out that Sumatra produces the finest oil in the world, but the difficulties of mining are so great that the output is small. It is impossible for white men to work any length of time, and there are no roads and no lumber, the only supply being the native lumber, whipsawed out of the logs on the spot. The oil is very high grade paraffin, which comes out of the ground so clear as to be almost transparent, and, though a market exists, the difficulties encountered by the producer are so great that it is next to impossible to guarantee supply. The market does not take a high grade of refined oil; what they buy is used in open lamps not unlike ordinary oil torches. All over the Orient there are millions of these little lamps, in which the people burn thousands of gallons of second grade refined oil.

Every year California oil has been sent in increasing quantities to the Far East. The Standard has some of the largest of its oil-carrying sailing vessels trading regularly between California and Japan and China. Standard case oil steamers are employed in this trade; while two years ago, when the Russian export trade absolutely ceased owing to the destruction of the oil fields, Mr. Chambers, the representative of the Standard, was recalled from Baku, and steamers which had been going to Batoum for oil were ordered to San Francisco to load California oil for the chief distributing ports in China and Japan.

The Union has a large fleet of vessels in the coastal and island trade. Two years ago seven vessels did the company's work, but in 1906 it purchased three additional tank steamers—*Lansing*, *Santa Rita* and *Santa Maria*—with a total carrying capacity of nearly seven million gallons. The *Santa Maria* was formerly the Atlantic liner *Minnetonka*, while the sister ship, *Santa Rita*, was the *Minnewaska*.

The leading companies operating in the oil fields of California—the Standard, Union and Associated—are increasing their oil-carrying fleets, and quite a number of the largest steamers have started to run regularly between San Francisco and Japan and China.

The Associated Oil Company has the tank steamer *W. S. Porter*. Burning oil fuel and carrying 4,000 tons of general cargo, she made the run of 13,500 miles from New York to San Francisco with the same company's steam tug *Navigator* in tow. The *Navigator*, purchased by the oil company from the Scully Towing Company, was for eight years one of the most powerful tugs employed in New York Bay, and acted as a committee boat at the International Yacht Races. She is employed by the Associated towing oil-carrying craft at San Francisco.

The Graciosa Oil Company, connected with California Petroleum Refineries, of London, purchased a tank steamer for its Pacific trade from the J. M. McDuffer Oil Company, New York, and it is stated that other vessels are being built for the company and its offshoots.

The oil business of California is not likely to stand still. Rather does it promise to go on prospering for many years to come. The oil fields are expanding, new refineries are being built, the commercial part of the industry, judiciously and carefully fostered and protected, goes on improving, and there is every indication that in a few years employment will be found for many more vessels than are running in the oil trade of the Pacific to-day.

I can only deal with the number of oil-carrying vessels in a general way, for directly we leave the ocean-going fleets we see how absolutely impossible it is to get even approximately near to the number of smaller vessels engaged in the petroleum transport trade.

In 1880 there were only eight oil-carrying steamers and sailing ships, four of each, and these were only employed in local trades. About 1887 some fourteen steamers and two sailers were built, and several of these were employed in the Transatlantic trade. In 1888 eighteen steamers, with a gross carrying capacity of 42,047 tons, were built by one shipbuilding company alone, while a single sailing ship, with a gross tonnage of 1,254, was launched.

Great difficulty was experienced in getting crews to ship on these steamers. Sailors regarded sailing on them as an act of suicide. Success, however, followed the enterprise of oil shippers and the owners of the steamers, and the fleet of tankers increased with such great rapidity that in 1890, only three years after they had started to run, sailers were practically driven out of the Transatlantic oil trade.

In these early years it was found that, like all great inventions, the tank steamer gradually deprived thousands of men of employment. Gangs of stevedores and labourers who made good wages loading vessels with cases and barrels were not needed; the tanker employed her own pumps or loaded by gravity from the storage tanks or pipe lines. Coopers were no longer in demand for the making of barrels; the tanks were made of iron and were permanent. Dunnage wood dealers had no market for their cordwood to prevent cargo from shifting; the tanks were

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permanent structures. Ballast was not needed, for when steamers discharged the tanks were filled with water.

In 1893, a great shipbuilding year, no less than thirty tankers, with a gross tonnage of 94,568, were launched. In 1898 there were some 150 ocean-going steamers and fourteen sailing vessels carrying oil. Only one of each was registered at New York, while seventy steamers and two sailing vessels were registered at British ports. Hamburg and Rotterdam had ten each, while Astrakhan and Baku had twelve each. At that time the Tyne had constructed seventy-seven out of the total of 121 oil-carrying steamers turned out of British shipyards. Sunderland came next with ten, while the Clyde, now a foremost tanker-building river, followed with eight.

If we include Caspian tankers—large, full-powered vessels not unlike the *J. M. Guffey*, *Col. Drake* and other steamers running in the Texas oil trade—there must be nearly 400 steamers carrying oil in all parts of the world. The largest number, likewise the tankers of the largest tonnage, fly the Union Jack. Tank steamers move over 90 per cent. of the oil in ocean trades.

In the Far East there are numerous small tankers owned by the Shell and Royal Dutch combination, and there have for many years been small steam oil-carriers on the rivers and lakes of America and Canada. One of the smallest tank steamers in the world is the *Tip-Top*, employed in New York harbour carrying oil for the Leonard and Ellis Oil Company, of Edgewater, N.J. She is equipped with a 300 h.-p. Standard gasoline marine engine, made by the Standard Motor Construction Company, Jersey City, and is 58·3 ft. by 10·7 ft. by 5·1 ft. Besides carrying oil in her own tanks she tows oil barges.

Then there are the sailers—many of them full rigged ships—trading to the islands in the Pacific and the Far East, numerous small coasting vessels equipped to carry oil, and large sea-going barges of the type used by the Standard Oil Company to take oil away from ports in the Gulf of Mexico. It would be impossible to compute the aggregate tonnage of the world's oil-carrying craft.

Nor must we forget the oil-carrying barge systems of the world.

Bulk oil barges have been employed in America for nearly half a century. In the exciting days of 1865* transport by the Allegheny river was improved by the use of oil-carrying barges. Each barge carried from 1,500 to 2,000 barrels, was 100 ft. to 130 ft. long, 22 ft. broad, from 3½ to 4½ ft. in depth, and divided into eight or nine water-tight compartments. Arrangements were made with the mill-owners at the head of Oil Creek for the use of their surplus water at intervals. The barges and different kinds of craft were towed up the creek by horses, not by a tow-path, but through the stream, to the various points of loading, and, when laden, were floated off on a pond freshet. As many as 40,000 barrels were taken away from the creek on a single artificially created freshet, but the average was about 15,000 or 20,000 barrels.

At Oil City the oil was transhipped to larger boats, and floated down the river to the refineries at Freeport, Pittsburg, Rochester, Mingo, Wheeling, Marietta, and Parkersburg. Bulk oil craft also carried oil from Burning Springs on the Kanawha River. At one time over 1,000 boats, thirty steamers, and about 4,000 men were engaged in this traffic at Oil City. At times, great loss occurred from collisions and jams; during one freshet (May, 1864), a jam resulted in the loss of 1,260,000 gallons of oil.

In some countries barges run in the coastwise trade. A number of the half whaleback type carry California oil along the Pacific Coast. Some of these are built of the finest Oregon pine, carry upwards of 1,000 tons, and have all the requisite machinery for the rapid handling of oil, along with the latest systems of electric lighting and ventilation. They are curiously built, have four masts, no bulwarks, and only a hand rail amidships. The Union Oil Company of California introduced this new style of oil-carrier. Since the oil transportation arrangements of the San Francisco oil companies have been brought up to date by the employment of numerous tank steamers these barges have had to face serious competition, but hundreds are still in service.

One of the best barge systems in the world has been adopted in the Gulf of Mexico, where Texas oil is loaded for ports as high up the coast as Philadelphia and New York. The largest barges are owned by the Standard Oil Company, and their suitability for the trade and exceptional seaworthiness have been demonstrated by several of them being towed across the Atlantic by oil-carrying steamers.

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* At the close of this year the oil pipe lines of America measured twelve miles—Van Sickle's pipe, Pithole (then an oil city, to-day a prairie waste without an inhabitant) to Millar Farm, five miles; and the Pennsylvania Tubing and Transportation Company's pipe, Pithole to Oleopolis, seven miles. To-day the pipe lines of America would girdle the world.

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The barge system is worked to great perfection on the Volga and several other Russian rivers. Included in the Volga fleet of oil carriers (referred to in the chapter on the Baku-Volga transport trade) are numerous miniature tank steamers, some of which use Diesel oil engines instead of the oil fuel burning arrangement adopted on the steamers of the Caspian Sea.

The Danube is also another great water-way used for oil transport, and several of the oil-producing countries of Europe, including Russia, make use of it in reaching the markets of Bavaria and South Germany. Roumanian oil was sold in Eastern Europe, the Balkan States and Turkey, but eight years ago Russian oil cut down the prices and compelled Roumanian competitors to search for new markets in England and Germany. Five years ago—when the International Commission controlling navigation on the Danube converted the rapids of the Iron Gate (Roumanian-Hungarian frontier) into a navigable canal—the Roumanians sought to get a foothold in the South of Germany; they sent tank barges up the Danube, passing through Hungary and Austria, and going on to Bavaria, where the oil was stored in huge depôts at Regensburg. Roumanian oil is now very popular in certain parts of Germany. Tank vessels trade regularly between all the important towns on the Danube.

There are many refineries on the banks of the Danube, and the oil men of Galicia, working at a considerable distance from a convenient seaport, have devoted a great deal of attention to the development of their export business through the medium of the chief rivers of Austria.

On every great water-way in the world (including the Thames, where the Anglo-American Oil Company have a fleet of screw tugs and tank barges) there are bulk oil-carrying vessels. At Manchester the idea of running illuminating and fuel oil-carrying barges from the storage installations at Trafford Park all over the canal systems of this country—as far as Leeds and London—has received support in influential quarters, and designs for a good type of tank boat for navigating the canals through narrow locks have been prepared by Mr. Marshall Stevens and Mr. Francis Wiswall, engineer of the Bridgewater Canal. Oil-carrying barges could navigate the following inland canals:—Bridgewater, Leeds and Liverpool, Bolton and Bury, Rochdale, Ashton, Huddersfield, Stockport, Macclesfield, Calder and Hebble, Peak Forest, Aire and Calder, Trent and Mersey, Weaver Navigation and Shropshire Union.

On succeeding pages I give the most reliable and complete list of the oil-carrying steamers published.

NO matter in what form we evolve artificial light, we depend upon petroleum. The illuminating portion of gas depends upon petroleum, gas lamps are fed with petroleum, candles are made of a form of petroleum, electric lamp carbons are made from petroleum, the filaments in incandescent lamps are made from petroleum, and, strange as it may seem, these latter are made almost entirely from gasoline.

Dr. A. W. Burrell, Texas.

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SHIPBUILDERS' LISTS OF OIL-CARRYING VESSELS.

ARMSTRONG, WHITWORTH & CO., LTD.,

Newcastle and Walker.

Date.	Name.	Owners.	Port.	Register. Gross.	Net.	Dimensions. Length.	Breadth.	Depth.	Cylinders. H.P.	M.P.	L.P.	Stroke.	Pressure.	Remarks.
1886	Gluckauf	Deutsch-Amerik. Petroleum Gest.	Geestemunde	2307	1503	300·5	37·2	23·2	22	35	58	36	150	
,,	Vorwarts	C. Wedekind & Co.	,,	2466	1604	300·5	37·2	23·2	22	35	58	39	...	Lost at sea, July, 1890.
1887	Hans and Kurt (now Oural) ...	... ...	... ...	2432	1634	270·0	39·0	21·2	20½	34	55	36	...	
,,	Oural (ex. Hans and Kurt) ...	Soc. Anon. d'Ar. d'Ind. et de Com.	Antwerp	2158	1654	270·0	39·2	21·2	20½	34	55	36	...	
,,	Ville de Calais	P. Paix & Co.	Calais	1837	1190	260·0	37·0	20·5	20	33	53	36	...	Destroyed by explosion at Calais.
,,	Willkommen	Deutsch-Amerik. Petroleum Gest.	Hamburg	2893	2297	315·0	41·2	23·8	30	37	72	48	100	
1888	Caucase (now Joannis Coutzis) ...	L. Lambert	Antwerp	1644	1381	250·0	35·2	24·4	18½	30	48	33	150	
,,	Darial (now Genesee)	Darial SS. Co.	London	2767	1814	310·0	40·2	28·3	23	37	60	39	...	
,,	Elbruz (now Ottawa)	Elbruz SS. Co.	,,	2716	2101	309·5	40·4	28·2	23	37	60	39	160	
,,	Energie	Deutsch-Amerik. Petroleum Gest.	Geestemunde	2765	2071	310·0	40·4	28·3	23	37	60	39	160	
,,	Genesee (ex. Darial)	Anglo-American Oil Co.... ...	London	2830	1833	310·0	40·2	28·3	23	37	60	39	...	
,,	Gut Heil	Deutsch-Amerik. Petroleum Gest.	Geestemunde	2736	2096	310·0	40·2	28·3	23	37	60	39	...	
,,	Joannis Coutzis (ex. Caucase) ...	J. G. Courtzis	Piræus	1644	1381	250·0	35·2	24·4	18½	30	48	33	150	
,,	Kasbek (now Suwanee)	Kasbek SS. Co.	London	2707	2098	310·0	40·4	28·3	23	37	60	39	...	
,,	La Hasbaye (ex. Œvelgonne) ...	American Petroleum Co. ...	Rotterdam	2568	2116	300·0	39·2	28·1	21½	35	57	38	...	
,,	La Flandre...	,, ,, ,, ...	,,	2018	1278	270·0	37·7	25·9	20	34	55	36	...	
,,	Lux	W. Dickinson & Co.	London	1635	1255	250·0	35·1	24·1	18½	30	48	32	...	Lost off coast of Greece, November, 1891.
,,	Œvelgonne (now La Hasbaye) ...	... ...	Rotterdam	2539	1987	300·0	39·2	28·1	21½	35	57	39	...	
,,	Ottawa (ex. Elbruz)	Anglo-American Oil Co.... ...	London	2742	2074	309·5	40·4	28·2	23	37	60	39	...	
,,	Paula	Deutsch-Amerik. Petroleum Gest.	Hamburg	2675	2160	285·0	40·2	30·4	22	35	58	39	...	
,,	Russian Prince	Prince Line	Newcastle	2716	2102	310·0	40·4	28·3	23	37	60	39	...	
,,	Sophie	Actien-Gest. Atlantic	Bremen	1362	1114	234·8	32·3	23·0	17½	28	46	30	...	
,,	Suwanee (ex. Kasbek)	Anglo-American Oil Co.... ...	London	2736	2075	310·0	40·4	28·3	23	37	60	39	...	
1889	Burgermeister Petersen ...	Deutsch-Amerik. Petroleum Gest.	Hamburg	2794	2090	310·0	40·2	28·3	23	37	60	39	...	
,,	Elise Marie	,, ,, ,, ,,	,,	3194	2424	320·0	42·0	29·5	23	37	60	42	...	
,,	Kura	Kura SS. Co.(Stephens & Mawson)	Newcastle	2372	1558	294·0	37·7	26·6	22½	36½	60	39	160	
,,	Lumen	Lumen SS. Co.(H. E. Moss & Co.)	Liverpool	2357	1554	294·0	37·7	26·6	21	35	57	36	...	
,,	Oranje Prince	Prince Line	Newcastle	1868	1214	260·0	36·0	25·7	19	31	51	36	...	
,,	Phosphor	Lennard's Carrying Co.	Middlesbro'	2023	1326	270·0	37·7	25·9	20	34	55	36	...	Lost, July, 1904.
1890	Beacon Light	Bear Creek Oil and Shipping Co.	Liverpool	2763	2107	311·0	40·2	28·2	23	37	60	39	...	
,,	Bear Creek...	,, ,, ,, ,, ,, ,,	,,	2411	1573	294·0	37·7	26·6	22	36	59	39	...	Abandoned in mid-ocean, December, 1892.
,,	Brilliant	Deutsch-Amerik. Petroleum Gest.	Geestemunde	3162	2411	319·2	42·0	29·5	23	37	60	48	...	
,,	Ewo	W. Keswick	London	423	260	149·0	27·4	11·5	13	21	34	27	...	
,,	Geestemunde	Deutsch-Amerik. Petroleum Gest.	Geestemunde	2750	1758	310·0	40·2	28·2	23	37	60	39	...	
,,	Helgoland	,, ,, ,,	,,	2397	1563	294·0	37·6	26·5	21	35	57	36	...	Sunk off Newfoundland, January, 1900.
,,	Makkayei	M. & J. Rosenstien Bros. ...	Odessa	1651	1033	260·5	36·1	19·8	21	34	56	36	160	
,,	Standard	Deutsch-Amerik. Petroleum Gest.	Geestemunde	2764	2110	309·5	40·2	28·3	23	37	60	39	...	

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ARMSTRONG, WHITWORTH & CO., LTD.—*continued.*

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1890	VILLE DE DOUAI	P. Paix & Co.	Calais	1871	1406	265·0	37·0	23·4	20	33	53	36	...	Just sold to the Standard and renamed *Edward Dawson.*
1891	ARAL	Rover Shipping Co.	Liverpool	2826	2160	310·0	40·2	28·2	22	35	58	42	...	
,,	WEEHAWKEN...	Anglo-American Oil Co.... ...	London	2784	2101	310·0	40·2	28·2	22	35	58	42	...	
1892	AZOV	W. Keswick	Liverpool	2332	1512	285·0	38·5	25·9	22	36	59	39	...	
,,	BAKU STANDARD	European Petroleum Co. ...	London	3708	2375	330·6	43·0	29·9	24	40	64	48	160	
,,	CADAGUA	Fourcade y Provot	Bilbao	2394	1858	295·0	39·0	25·4	22½	36	59	39	160	
,,	DIAMANT	Deutsch-Amerik. Petroleum Gest.	Hamburg	3525	2270	330·0	43·0	29·9	24	40	64	48	160	
,,	EL GALLO	Desmarais Hermanos	Santander	632	362	170·5	28·0	14·5	16½	26	43	27	160	
,,	ETELKA	Photogen Soc. Anon. Transports	Fiume	2373	1524	289·0	37·4	26·3	22	36	59	39	160	
,,	LE PROGRÈS	Cie. Univ. de Canal Marit. de Suez	Port Said	449	205	164·6	27·0	13·6	16	4cy.	30	18	...	
,,	LUCERNA	Lucerna SS. Co. (H.E. Moss & Co.)	Liverpool	3242	2072	330·0	42·6	28·5	24	40	65	42	160	
,,	MANNHEIM	Deutsch-Amerik. Petroleum Gest.	Hamburg	3506	2257	330·0	43·0	29·8	24	40	64	48	160	
1893	GEORGIAN PRINCE	Prince Line	Newcastle	3245	2078	328·0	42·0	26·85	24	40	65	42	160	
,,	JAMES BRAND	European Petroleum Co. ...	London	3907	2512	340·0	44·1	29·9	25	41	67	48	160	
,,	SNOWFLAKE	Bear Creek Oil and Shipping Co.	Liverpool	2710	1726	294·0	39·6	26·75	23	37	60	42	160	
,,	LUCIGEN	Lucigen SS. Co.	,,	3416	2183	330·0	42·7	28·4	24	40	64	48	160	Sold this year to Anglo-American Oil Co.
,,	TONAWANDA (ex. Lucigen)	Anglo-American Oil Co.... ...	London	3416	2183	330·0	42·7	28·4	24	40	64	48	...	
1894	EUPLECTELA	Shell Transport and Trading Co.	,,	3918	2507	340·0	44·0	29·9	25	41	67	48	160	Converted steamer. Sold to Lane & Macandrew this year and resold later to the Asiatic Petroleum Co.
,,	MAMEDSHAKH	Rasouloff & Co.	Astrakhan	552	324	150·0	27·9	13·4	20	2cy.	38	24	...	
1895	COWRIE	Shell Transport and Trading Co.	London	4893	3155	376·0	48·0	29·9	27½	43½	73	48	160	
,,	LE COQ	LeCoq SS. Co. (Lane & M'andrew)	Newcastle	3399	2169	330·0	42·7	28·4	24	40	64	48	160	
,,	NERITE	Shell Transport and Trading Co.	London	4893	3155	376·0	48·0	29·9	27½	43½	73	48	160	Destroyed by fire in Suez Canal.
1896	BORJOM	Soc. de l'Ind. de Naphte et du Com.	Batoum	2874	1848	310·0	42·0	22·1	24	40	64	42	160	
1897	MINISTER MAYBACH...	Deutsch-Amerik. Petroleum Gest.	Geestemunde	2486	2042	285·0	40·2	23·1	22	35	58	39	150	
,,	MECHTI	Nagi Mechtieff	... ...	789	483	180·0	31·5	14·5	26	2cy.	48	27	...	
,,	RASOUL	M. Rasouloff	Astrakhan	997	613	218·0	32·0	15·0	19	...	36	24	...	
,,	SAMARKAND	A. A. Dadascheff	Baku	976	596	218·0	32·0	15·0	20	2cy.	36	24	...	
,,	USEINIA MANAFOFF	A. Manafoff	Astrakhan	1041	636	218·0	32·0	15·7	19	4cy.	36	24	...	
1898	ASIA	Shamsi Asadoulaieff	,,	1169	716	230·0	32·0	17·0	19	...	38	24	...	
,,	DAGHESTAN	Soc. Anon. d'Ar. d'Ind. et de Com.	Antwerp	2818	1801	304·0	40·0	25·4	24	38	64	42	...	
,,	HALIOTIS	Ned. Ind. Indus. en Handel Maats	... ...	1659	1046	242·0	40·2	17·3	30	2cy.	63	39	100	
,,	TRIGONIA	,, ,, ,, ,,	... ...	1667	1069	242·0	40·2	17·3	30	2cy.	63	39	100	
1899	LUCILINE	Luciline Navigation Co. (L.&M.)	London	3765	2424	335·7	45·0	28·6	24	40	64	48	...	
,,	ORIFLAMME	Oriflamme SS. Co. (L. & M.) ...	,,	3764	2424	335·7	45·9	28·6	24	40	64	48	...	
,,	SAXOLEINE	Saxoleine SS. Co.	Newcastle	3757	2426	335·7	45·0	28·5	24	40	64	48	...	
1900	BULYSSES	Shell Transport and Trading Co.	London	6069	3958	410·0	52·1	32·2	28	46	77	48	180	
,,	CARDIUM	,, ,,	,,	6068	3953	410·0	52·1	32·2	28	46	77	48	180	
,,	STROMBUS	,, ,,	,,	6030	3928	410·0	52·1	32·2	28	46	77	48	180	
,,	TIFLIS	Soc. Anon. d'Ar. d'Ind. et de Com.	Antwerp	2816	1807	304·3	40·0	25·3	24	39	64	42	...	
,,	KHODOUNG	Burmah Oil Co.	Rangoon	1457	913	235·0	34·2	15·6	19	31	51	36	180	
1901	PINNA...	Shell Transport and Trading Co.	London	6288	4100	420·8	52·1	32·2	28	46	77	48	180	Transferred to Lane & Macandrew.
,,	KINSMAN (now Winnebago) ...	Bear Creek Oil and Shipping Co.	Liverpool	4534	2965	360·0	49·7	28·7	24	40	66	48	180	
,,	WINNEBAGO (ex. Kinsman) ...	Anglo-American Oil Co.... ...	London	4534	2965	360·0	49·7	28·7	24	40	66	48	180	
1902	PURE OIL	Pennsylvania Trading Co. ...	Hamburg	4487	2917	370·0	48·5	29·6	25	42	70	48	180	Abandoned at sea, 1902
,,	ROMANY (now Rossija)	Deutsch-Russis Nap. Imp. Gest.	,,	3983	2579	350·0	47·0	27·6	25	42	68	45	180	

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ARMSTRONG, WHITWORTH & CO., LTD.—*continued.*

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1902	TUSCANY (now Dakotah)	Tuscany SS. Co.	London	4006	2593	350·0	47·0	27·6	25	42	68	45	180	
,,	DAKOTAH (ex. Tuscany)	Anglo-American Oil Co.	,,	4006	2593	350·0	47·0	27·6	25	42	68	45	180	
,,	TWINGONE	Burmah Oil Co.	Rangoon	1771	1120	250·0	36·5	16·8	20	33	54	36	180	
,,	CYMBELINE	Bear Creek Oil and Shipping Co.	Liverpool	4505	2940	370·0	48·5	28·7	25	42	70	48	180	
,,	LUCIGEN	Moss & Co.	,,	4527	2929	370·3	48·5	28·8	26	44	72	48	180	Transferred to Anglo-American this year.
1903	SILVERLIP	Shell Transport and Trading Co.	London	7492	4904	470·0	55·2	33·1	29½	48	78	54	180	
,,	SINGU...	Burmah Oil Co.	Rangoon	3037	1913	309·5	41·5	20·5	22	37	61	42	180	
1904	BEME	,, ,, ...	,,	3039	1899	310·0	41·5	27·5	22	37	61	42	180	
,,	NERITE	Ned. Ind. Indus. en Handel Maats	Amsterdam	2042	1267	258·1	46·2	18·2	20½	33	54	36	180	Replaced old *Nerita* destroyed by fire.
1906	HERMIONE	Bear Creek Oil and Shipping Co.	Liverpool	4519	2904	370·0	48·5	28·75	25	42	70	48	180	Sold to Japanese this year.
,,	SAN CRISTOBAL	Cia Mex. de Vap. del Aquila, S.A.	London	2041	1280	258·0	46·3	18·3	20½	33	54	36	180	Sir Weetman Pearson's Anglo-Mexican Co.
,,	No. C. 119	British Admiralty...	... ...	337	337	130·6	32·2	8·4	...	...	...	...	...	Turret steamer like the Shell vessels *Haliotis* and *Trigonia*.
,,	No. C. 158	,, ,, ...	... ...	337	337	130·6	32·2	8·4	...	...	...	...	...	
,,	No. C. 81	,, ,, ...	... ...	337	337	130·6	32·2	8·4	...	...	...	...	...	

PALMERS SHIPBUILDING AND IRON CO., LTD.,

NEWCASTLE AND JARROW.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1887	APSCHERON (ex. Era)	Soc. Anon. d'Ar. d'Ind. et de. Com.	Antwerp	1850	1386	271·0	37·2	15·2	21	34	57	39	154	
,,	ERA (now Apscheron)	Era SS. Co.	London	1851	1195	271·0	37·2	15·2	21	34	57	39	154	
1888	BROADMAYNE (ex. Oka)	European Petroleum Co. ...	,,	3120	1947	334·4	44·0	16·9	26	43	69	45	150	
,,	OKA (now Broadmayne)	,, ,, ,, ...	,,	3095	1995	334·4	40·0	16·9	26	43	69	45	150	
1889	ASTRAL (now Salahadji)	Astral SS. Co. (W. Tapscott & Co.)	Liverpool	2249	1465	281·0	38·2	18·3	21	34	57	39	160	
,,	PRUDENTIA	Lennard's Carrying Co.	Middlesbro'	2776	1774	312·0	40·2	19·8	24	38	62	42	150	
,,	RION	Rion Co. (Stephens & Mawson)	Newcastle	2186	1419	279·0	37·7	19·1	22	35	58	39	150	
,,	SALAHADJI (ex. Astral)	Royal Dutch Co.	S'Gravenhage	2280	1471	281·0	38·2	18·3	21	34	57	39	160	
1890	LA CAMPINE	American Petroleum Co. ...	Rotterdam	2595	2141	309·7	39·0	26·3	22	35	58	42	...	
,,	LANSING (ex. British Queen) ...	Michigan SS. Co.	New York	4561	3429	400·0	47·2	27·9	29	47	76	51	150	
1892	AMERICAN	American Petroleum Co. ...	Rotterdam	3526	2266	345·4	44·1	27·6	27	44	72	48	...	
,,	ASTRAKHAN	Rover Shipping Co.	Liverpool	3438	2236	330·0	42·9	28·7	24	40	64	42	160	
1893	ARAS	Aras SS. Co. (Stephens & Mawson)	Newcastle	3210	2088	325·0	42·7	28·5	24	40	64	42	160	
,,	ERIVAN	Soc. Anon. d'Ar. d'Ind. et de Com.	Antwerp	2395	1631	285·0	38·6	25·8	22½	30½	60	42	...	
1895	ROTTERDAM	American Petroleum Co. ...	Rotterdam	4140	2635	360·0	46·7	27·7	28½	46	75	48	160	Has two smoke stacks.
1902	NEW YORK	,, ,, ,, ...	,,	6859	4463	428·0	54·7	30·4	28	46½	77	54	180	
1903	GRAF STROGANOFF (now Ashtabula)	Anglo-American Oil Co.	London	7025	4527	428·0	54·7	30·5	28	46½	77	54	180	Originally built for Northern SS. Co., St. Petersburg.
,,	PROMETHEUS	Deutsch-Amerik. Petroleum Gest.	Hamburg	6448	4172	428·0	54·7	30·5	28	46½	77	54	180	

Although it is twenty years since the *Apscheron* was launched, no tank steamer built at Jarrow has been lost. These vessels are all running in the oil trade to-day.

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W. GRAY & CO., LTD.,

West Hartlepool.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1881	Harry Luckenbach	Luckenbach Tran. & Wrecking Co.	New York	2798	1799	300·0	40·2	24·5	40	...	75	45	...	
1886	Bakuin	P. T. & S. Co. (A. Suart) ...	London	1669	1093	260·4	36·0	17·5	21	35	57	39	150	Destroyed by fire at Peru, September, 1902.
1887	Washtenaw (ex. Oxford)	Michigan SS. Co.	New York	2897	2004	315·3	42·6	25·0	24¾	41	66	45	150	
1892	Argyle	,, ,, ...	,,	2953	1880	320·2	40·7	24·4	25	40	65	42	160	
,,	Murex	Shell Transport and Trading Co.	London	3564	2329	338·0	43·0	26·4	25½	40½	67	45	160	
,,	Conch	,, ,, ,, ...	,,	3555	2314	338·4	43·0	26·4	25½	40½	67	45	160	
1893	Bullmouth	,, ,, ,, ...	,,	4018	2607	347·0	45·6	26·7	26	42	70	45	160	
,,	Clam	,, ,, ,, ...	,,	3552	2311	338·0	43·0	26·4	25½	40½	67	45	160	
,,	Elax	,, ,, ,, ...	,,	4015	2612	347·2	45·6	26·7	26	42	70	45	160	
,,	Volute	,, ,, ,, ...	,,	4006	2599	347·0	45·6	26·7	26	42	70	45	160	
1895	Pectan	,, ,, ,, ...	,,	4778	3123	375·6	48·0	29·8	27½	43½	73	48	160	Sunk, September, 1898.
,,	Telena	,, ,, ,, ...	,,	4778	3124	375·5	48·0	29·8	27½	43½	73	48	160	
1902	Pectan	,, ,, ,, ...	,,	7291	4752	471·0	55·0	32·9	29½	48	78	54	180	
1903	Spondilus	,, ,, ,, ...	,,	7300	...	...	...	...	29½	48	78	54	...	

HAWTHORN, LESLIE & CO.,

Newcastle and Hebburn.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1879	Petriana	Shell Transport and Trading Co.	London	1821	1148	260·5	34·2	21·7	33	...	62	42	80	Went ashore at Point Nepean and abandoned, November, 1903.
,,	Vindobala	P. T. & S. Co. (A. Suart) ...	,,	1865	1167	261·0	34·3	21·8	33	...	62	42	80	Abandoned, 1898.
1881	Robert Dickinson	Shell Transport and Trading Co.	,,	2100	1331	278·7	35·4	22·5	36	...	68	42	75	Now *Fumi Maru*.
,,	Fumi Maru (ex. Robert Dickinson)	Mikami & Tanaka	Kobe	2100	1331	278·7	35·4	22·5	36	...	68	42	75	
1886	Looch	Russian S. N. & T. Co.	Odessa	1446	914	255·5	34·2	17·9	20	32	53	36	150	
,,	Loutsch	,, ,, ...	,,	1452	914	255·5	34·2	17·9	20	32	53	36	150	
1896	Hafis (now La Madeleine) ...	Deutsch-Amerik. Petro. Gest. ...	Geestemunde	2116	1588	270·0	36·0	...	20	32	53	36	...	
,,	La Madeleine (ex. Hafis)... ...	S. C. de Port St. Louis de Rhône	S. L. de Rhône	2116	1588	270·0	36·0	...	20	32	53	36	...	

RAYLTON, DIXON & CO.,

Middlesbrough.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1893	Hotham Newton	Lennard's Carrying Co.... ...	Middlesbro'	2661	1713	310·0	41·0	18·3	24	39	64	42	160	

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SHELL STEAMERS IN THE DRY DOCK AT GENOA.

[Holzapfel's Photo.

THIS view of the oil storage facilities on the Manchester Ship Canal was taken from the North, and only shows the tanks at Mode Wheel (sixteen in number). These have a capacity of 7,021.671 gallons, out of a total for the port of 22,141,358 gallons. The British Petroleum Company, Ltd., have at Eccles five tanks, capacity 22,000 tons (6,160,000 gallons), and at Weaste four tanks, capacity 8 600 tons (2,460,075 gallons); at Mode Wheel the Anglo-American Oil Company, Ltd., have eight tanks, capacity 11,348 tons (3,177,500 gallons); the Liverpool Storage Company, Ltd., six tanks, capacity 10,000 tons (2,800,000 gallons); the Manchester Corporation two tanks, capacity 4 016 tons (1,044,171 gallons). In Trafford Park, which is alongside the Ship Canal, the British Petroleum Company, Ltd., have two tanks, capacity 7,000 tons (2,059,612 gallons); the Homelight Oil Company, Ltd., two tanks, capacity 8,000 tons (2,200,000 gallons); and the General Oil Storage Company, Ltd., one tank, capacity 8,000 tons (2,240,000 gallons). The total tankage capacity at, or adjacent to, the Docks is now 78,964 tons (22,141,358 gallons). Oil is conveyed to the depôts through pipes direct from the vessels to the tanks. From these it is reloaded into carts, barges, or railway waggons.

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UNIV. OF MICH.

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W. DOBSON & CO., LTD.,

NEWCASTLE.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1894	ALLA VERDI	Manafor	Astrakhan	994	676	252·5	27·8	17·1	14	22	36	27	...	
,,	AMASIE	Armenian SS. Co.	Baku	543	369	150·3	28·0	13·7	22	2cy.	42	24	...	
,,	GRIGOR ARZROUNI	Madame Sarkisoff	,,	545	271	150·3	28·0	13·7	22	2cy.	42	24	...	
,,	VARDAU ZORAVAR	Dildaroff & Co.	,,	540	369	150·0	28·0	13·8	22	2cy.	42	24	...	
,,	VOROTAN	A. Pogosoff & Co.	,,	543	369	150·5	28·0	13·7	22	2cy.	42	24	...	
,,	ALEMBIC (sailing vessel)	Burt, Boulton & Haywood, Ltd.	London	255	219	122·5	24·1	13·1	...	...	...	...	...	
1895	ALCHYMIST	,, ,, ,, ...	,,	382	209	147·5	24·1	12·8	12½	20	33	24	...	
1897	ASHOT ERKAT	Armenian SS. Co.	Astrakhan	1053	716	224·0	32·0	17·4	20½	...	39	24	...	
,,	IGNATIEF	Kuznezoff Bros.	,,	1052	715	224·0	32·0	17·4	20	4cy.	38	24	...	
,,	JUPITER	Société Mazout	Baku	1435	976	375·0	32·0	19·0	22	4cy.	42	27	...	
1898	AGA MANAFOFF	M. S. Manafoff	,,	1108	754	238·0	32·0	16·7	20½	...	39	24	...	
1903	PADDY	A. Suart & Co.	,,	1200	800	248·0	32·0	17·5	20	...	41	27	...	

SIR JAMES LAING & SONS, LTD.,

SUNDERLAND.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1892	TURBO	Shell Transport and Trading Co.	London	4134	2659	347·5	45·7	27·3	26	42½	69	45	160	
1893	TROCAS	,, ,, ,, ...	,,	4129	2657	347·5	45·7	27·3	26	42½	69	45	160	
,,	SPONDILUS	,, ,, ,, ...	,,	4129	2658	347·5	45·7	27·3	26	42½	69	45	160	Wrecked, March, 1896.
,,	MEXICANO	King Line	Middlesbro'	1973	1264	270·0	38·2	22·6	21	35	57	39	...	
,,	SURAM	Suram SS. Co. (Step. & Mawson)	Newcastle	3629	2338	325·0	42·6	21·2	24	40	64	42	160	
,,	BATOUM	European Petroleum Co. ...	London	4054	2621	345·0	44·7	22·0	26	42	68	45	160	
,,	VEDRA...	,, ,, ...	,,	4057	2622	345·0	44·7	22·0	26	42½	69	48	160	
1898	SULTAN VAN LANGKAT	Royal Dutch Co.	Pang. Brand.	3035	2308	335·0	39·5	15·5	22	34	57	42	160	
,,	TUSCARORA	Anglo-American Oil Co.	Sunderland	6117	3925	420·4	53·2	29·1	29	48	78	54	170	
1899	BALAKANI	Lane & Macandrew	London	3696	2367	335·0	45·0	28·0	24½	40	66	45	180	
,,	TEREK...	,, ,, ...	,,	3710	2374	335·5	45·0	28·1	24½	40	66	45	180	
,,	CAUCASIAN	,, ,, ...	,,	4656	3003	365·3	49·8	28·0	25½	42	69	45	180	

R. DUNCAN & CO.,

PORT GLASGOW.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1887	FLORIDA	Texas Co.	Galveston	1596	1052	230·0	35·5	18·5	22	35½	57	39	...	

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DAVID J. DUNLOP & CO.,

Port Glasgow.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1889	Manhattan	Actien Gest. Atlantic	Bremen	3384	2183	330·0	42·2	21·2	26½	42	70	45	160	Pioneer Anglo-American Steamer.
1893	Delaware	Anglo-American Oil Co.	London	3855	2469	345·0	44·3	23·0	27	43½	70	51	160	
1894	Aco (now Helios)	... ...	... ...	3477	2211	333·5	43·2	21·6	25	40½	65	48	160	
„	Helios (ex. Aco)	Deutsch-Amerik. Petro. Gest. ...	Hamburg	3477	2211	333·5	43.2	21·6	25	40½	65	48	160	
„	Lackawanna...	Anglo-American Oil Co.... ...	London	3855	2468	345·0	44·3	23·0	27	43½	70	51	160	
1895	Chesapeake	„ „	„	4557	2925	370·0	47·1	27·8	27	43½	70	51	160	
1897	Osceola	„ „	„	393	123	140·5	26·1	10·8	13	21	34	24	160	
1903	Phœbus	Deutsch-Amerik. Petro. Gest. ...	Hamburg	6268	3638	420·0	53·2	29·1	29	48	78	54	170	

UNION IRON WORKS,

San Francisco.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1896	George Loomis	Pacific Coast Oil Co.	Richmond, C.	691	402	175·0	27·4	16·5	12¾	19	32	24	160	
1903	Whittier	Union Oil Co.	Los Angeles	1296	798	240·0	32·0	17·5	17	27	44	30	180	

CALEDONIAN S. B. & E. CO., LTD.,

Dundee.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1897	Abas Dadascheff	A. A. Dadascheff	Baku	1035	704	217·0	32·0	15·3	16	27	44	33	...	
1899	Venture	A. Suart & Co.	„	1330	...	248·0	32·0	17·3	22	4cy.	44	24	...	

W. CRICHTON & CO.,

Abo.

Date.	Name.	Owner.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1873	Abo	A. A. Dadascheff	Baku	365	283	160·0	26·0	12·2	20	2cy.	40	24	...	

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SWAN, HUNTER & WIGHAM RICHARDSON, LTD.,

NEWCASTLE.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1889	CIRCASSIAN PRINCE	W. Keswick	Newcastle	2258	1453	272·0	38·1	26·1	20½	33½	55	36	...	
1893	LUCIGEN	Lucigen SS. Co. (H.E. Moss & Co.)	Liverpool	3416	2183	330·0	42·7	28·4	24	40	64	48	...	Now *Tonawanda*, Anglo-American.
,,	MEXICAN PRINCE	Prince Line	Newcastle	3028	1953	328·3	41·0	19·5	23	38	62½	42	160	
1899	LUCIFER	Bear Creek Oil and Shipping Co.	Liverpool	3823	2473	344·4	47·1	20·9	24	39	66	45	180	Lost in the Atlantic, this year.
1901	MIRA	Mira SS. Co.	Newcastle	3700	2397	345·0	47·0	21·0	25	42	68	45	180	
1903	GOLDMOUTH	Shell Transport and Trading Co.	London	...	7112	471·0	56·0	33·2	29½	48	78	54	...	
,,	PETROLEUM	The Admiralty	... ...	4521	2958	370·8	48·7	29·3	25	41	69	48	...	Carries liquid fuel for warships.

BURMEISTER & WAINE,

COPENHAGEN.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1890	CHRISTINE (now Tioga)	Danske Petroleums Akiets ...	Aahus	2293	1458	280·9	27·3	18·5	22	35	57	39	...	
,,	TIOGA (ex. Christine)	Anglo-American Oil Co.... ...	London	2197	1378	276·7	38·0	25·7	22	35	57	39	...	
1898	RUDOLPH	Danske Petroleums Akiets ...	Copenhagen	198	163	108·7	23·1	11·5	...	...	...	...	...	Tank sailing vessel.

NUESCKE & CO.,

GRABOW.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1897	CHOROSAN	Mamedoff & Dschebracloff ...	Baku	546	302	151·4	28·1	13·8	17¾	2cy.	30¾	19½	...	

BOOLDS, SHARER & CO.,

SUNDERLAND.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1886	ANI	St. Petersburg Transport Co. ...	Astrakhan	371	294	140·0	24·0	11·3	9½	15	25	18	...	
,,	SEVAN...	,, ,, ...	,,	473	291	148·0	27·1	12·2	10½	16½	27	18	...	

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CRAIG, TAYLOR & CO.,

STOCKTON.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1889	TANCARVILLE...	European Petroleum Co. ...	London	2355	1534	292·5	37·2	18·4	22	35	60	42	160	Converted into Oil Depôt. Stationed in Far East.
1890	PETROLEA	A. Suart	,,	2331	1516	292·5	37·1	18·5	21	34	56	42	150	Lost by explosion, June, 1892.
,,	PRUDENCE	A. Suart & Co.	,,	2319	1515	292·3	37·0	18·5	22	35	57	39	160	Lost (stranded), January, 1892.
,,	ALLEGHENY	SS. Allegheny, Ltd. (A. Suart) ...	,,	2914	1911	320·0	42·2	19·2	25	40	66	45	150	Sunk in Delaware, 1st October, 1894.
1892	L'ORIFLAMME	A. Suart & Co.	,,	3328	2129	332·0	42·2	18·8	25	40	66	45	150	Sunk, January, 1899.
1893	ARETHUSA (ex. Luciline I.) ...	U. S. Government	U. S.	3319	2132	332·0	42·2	18·8	25	40	66	45	150	Now water boat.
,,	LUCILINE (now Arethusa)	Petroleum Shipping Co.... ...	London	3319	2132	332·0	42·2	18·8	25	40	66	45	160	
,,	SAINT HELENS	,, ,, (A. Suart)	,,	4007	2588	345·0	45·2	21·7	26	42	68	45	...	Lost, December, 1899.
,,	SAN IGNACIO DE LOYOLA	L. Mercador y Vda. de Londaiz	San Sebastian	675	621	173·0	31·1	15·2	...	...	...	...	...	Tank sailing vessel.

BERGSUNDS M. V. ACTIEB.,

STOCKHOLM.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1894	ALESGERJE	A. K. & A. Ousejnoff	Baku	606	445	151·9	26·9	13·5	24⅝	...	43	25⅝	...	
,,	ALI OUSEJNOFF	Iskenderoff	,,	599	445	151·8	26·9	13·3	24⅝	...	43	25⅝	...	
,,	MARTIN	S. M. Lionosoff	Astrakhan	583	437	152·0	26·9	13·1	24⅝	...	43	25⅝	...	
,,	MOSKVA	Solim & Masloff	,,	577	421	152·1	26·9	13·1	24⅝	...	43	25⅝	...	
1897	KAHN USEJNOFF	Ali U. Alesker & Aga D. Usejnoff	Baku	853	664	200·0	28·0	15·6	23	4cy.	54	24	...	
1898	TATJANA	C. Toumajeff	,,	1594	1252	283·5	31·5	18·6	24⅛	4cy.	51¾	25⅛	...	
1899	GANI OUSEJNOFF	Aga Dadasch Ousejnoff	,,	1077	810	218·6	31·1	17·4	24⅝	4cy.	51 9/16	25⅝	...	

RUSSELL & CO.,

GREENOCK AND PORT GLASGOW.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1882	MARION CHILCOTT	Matson Nav. Co....	P.Town.,U.S.	1738	1511	256·4	38·2	22·8	...	...	...	...	...	Tank sailing vessel.
1888	CHARLOIS	American Petroleum Co.... ...	Rotterdam	2677	1919	310·3	39·2	25·2	22	36	58	42	160	
,,	CHESTER	,, ,, ...	,,	2568	1637	311·7	39·2	25·0	22	36	58	42	170	
,,	OCEAN	,, ,, ...	,,	2560	1636	310·7	39·1	25·2	22	36	58	42	160	
1890	BREMERHAVEN	,, ,, ...	,,	3393	2179	339·6	42·6	26·1	25	40	66	42	160	Abandoned at sea, February, 1900.

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AMERICAN STEEL BARGE CO.,

Everett, W. Superior, Wis., and Lorain, O.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1894	City of Everett	Standard Oil Co.	New York	2504	1858	361·0	42·0	26·6	24	38	64	42	...	Whaleback tank steamer.
1895	S. O. Co., No. 76	„ „	„	794	780	175·0	23·1	15·5	...	...	...	...	...	Tank sailing vessel.
1899	S. O. Co., No. 86	„ „	„	1102	954	208·7	38·1	16·0	...	...	...	...	...	„ „ „
1900	Paraguay	Sun Oil Co.	Duluth, U.S.	2201	1323	242·0	42·0	26·5	23	35	54	36	...	

MOTALA CO.,

Gothenburg.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1885	Sviet...	Russian S. N. & T. Co.	Odessa	1827	1474	273·9	35·1	21·5	36	...	66	40	...	
1888	Ludwig Nobel (ex. Petrolea) ...	Naphta Production Gest. Nobel	Libau	965	557	191·7	29·4	19·5	26	...	50	27	...	Brought first cargo of bulk oil to the Thames.
„	Petrolea (now Ludwig Nobel) ...	... ...	London	976	744	191·7	29·4	19·5	26	...	50	27	...	
1890	Blesk	Russian S. N. & T. Co.	Odessa	2868	2076	316·9	40·0	26·7	24	39	64	42	...	Lost, December, 1896.

A. & J. INGLIS,

Glasgow.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1889	Bayonne	Actien Gest. Atlantic	Bremen	3294	2154	330·0	42·2	21·1	24	40	63	48	160	Originally Anglo-American Steamer.
1893	Potomac	Anglo-American Oil Co.... ...	London	3868	2472	345·2	44·2	23·0	27½	45	70	54	160	

BREMER "VULKAN,"

Vegesack.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1898	Bremer Vulkan	Dadasch Tagieff	Baku	759	471	184·4	29·7	14·7	13½	21½	34½	23½	...	

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TYNE IRON SHIPBUILDING CO., LTD.,

NEWCASTLE.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1893	APPALACHEE (ex. Duffield)	Anglo-American Oil Co., Ltd. ...	London	3767	2426	340·0	44·2	22·1	25½	41	68	48	160	Built for Hunting & Son. Transferred.
,,	DUFFIELD (now Appalachee) ...	North. Petro. Tank SS. Co., Ltd.	Newcastle	3767	2456	340·0	44·2	22·1	25½	41	68	48	160	
1895	AUREOLE	,, ,, ,,	,,	3975	2553	345·0	47·2	21·9	27	44	71	48	160	
1896	OILFIELD	Hunting & Son	,,	4005	2564	345·0	47·2	21·9	27	44	71	48	160	
1898	IMPERIAL (ex. Minoco)	Anglo-American Oil Co., Ltd. ...	London	796	412	200·0	32·0	14·4	17	26	45	30	160	Built for Mineral Oils Corporation, to run in the oil trade on the English coast. After trading for many years between Batoum and this country she was sold, and is now running on the lakes between the United States and Canada.
1899	BLOOMFIELD	Hunting & Son	Newcastle	4455	2869	350·0	50·2	22·5	27	45	74	48	180	

GREENOCK & GRANGEMOUTH DOCKYARD CO.,

GRANGEMOUTH AND GREENOCK.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1892	CIUDAD DE REUS	Sociedad la Mutua	Barcelona	1899	1210	260·0	36·2	17·0	20	33	54	36	160	
1893	LA VIGUESA	Babe & Co.	Vigo	665	636	171·7	31·1	15·0	...	...	...	...	...	Tank sailing vessel.
1899	KOKINE	Burmah Oil Co.	Rangoon	1427	891	235·0	32·6	15·9	19	31	51	36	180	Lost by fire, first trip.
,,	SYRIAM	,, ,, ...	,,	1427	891	235·0	32·6	15·9	19	31	51	36	180	
1903	PENNOIL*	Pennsylvania Trading Co. ...	Hamburg	4434	2819	363·8	50·1	27·5	26	42	70	48	180	

* A most successful vessel employed by the Pure Oil Company in the Atlantic trade. At summer Plimsoll, she carries 7,000 tons. Has 22 tanks, 2 pump rooms, and powerful steam fans for eliminating dangerous vapours. Fitted with most complete installation of electric light. Overhead trolley railways convey coal to stokehold from any part of extensive bunkers (1,500 tons). Steams 11 knots.

W. CRAMP & SONS,

PHILADELPHIA.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1903	COLONEL E. L. DRAKE	Standard Oil Co.	New York	4205	3424	360·0	50·0	28·5	25	41½	68	42	...	Towed first oil barge across the Atlantic.

F. SCHICHAW,

DANZIG.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1895	CZAR NICHOLAI II.	Mineraloelwerke, Albrecht & Co.	Hamburg	2076	1305	268·0	38·1	22·9	19	27	39+67	35	...	

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KETTE DENT, ELBSCHIFF GEST. SCHIFFSW.,

UEBIGAN.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1897	KETTE	A. A. Dadascheff	Baku	586	357	152·5	28·0	12·9	17¾	2cy.	30¾	19¾	...	
„	MENASTAN	Gebr. J. & J. Awetoff	„	586	322	158·0	28·0	14·4	17¾	...	30¾	19¾	...	
„	MISIRJE	R. B. Aschumoff	„	590	326	152·5	28·0	13·9	17¾	...	30¾	19¾	...	

CHICAGO SHIPBUILDING CO.,

CHICAGO.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1901	NORTHMAN	Northwestern S S. Co.	Fairport, U.S.	2157	1496	242·0	42·2	23·2	20	33	54	40	...	Converted, and now owned by Texas Company.
„	NORTHTOWN	„ „	„	2157	1496	242·0	42·2	23·2	20	33	54	40	...	„ „ „ „
„	NORTHWESTERN	„ „	„	2157	1496	242·0	42·2	23·2	20	33	54	40	...	„ „ „ „

FORGES ET CIE.,

HAVRE.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1893	Lux (ex. Le Lion)	... ...	... ...	2593	1339	283·3	39·9	26·2	23½	35½	55	47⅛	...	

NORD DEUTSCHE SCHIPPWERFT,

KIEL.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1872	LINDESNAES	Aktieselskabet Lindesnaes ...	Christiania	375	266	152·1	21·5	15·0	17½	...	28	24	...	

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OSWALD, MORDAUNT & CO.,

SOUTHAMPTON.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks
1888	VILLE DE DIEPPE	Acties. Union	Christiania	1254	1228	217·2	36·4	21·0	...	...	...	...	...	Tank sailing vessel.
1889	ROCKLIGHT	Shell Transport and Trading Co.	London	3284	2133	312·0	40·4	21·1	22½	37	61	39	165	Recently resold to L. & Mac., who originally owned her.

SCOTT & CO.,

GREENOCK.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1903	NARRAGANSETT	Anglo-American Oil Co.	Greenock	9196	5776	512·0	63·4	32·6	31	51	85½	60	200	Largest tank steamer

PEARCE BROS.,

DUNDEE.

Date.	Name.	Owner.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1887	POLLUX	W. S. Croudace	Dundee	1433	918	245·0	36·0	18·5	20	30	50	36	165	Abandoned, December, 1890.

CAIRD & PURDIE,

BARROW.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke	Pressure.	Remarks.
1881	RALEIGH	J. Wood & Co.	W. H'tlepool	1349	835	244·4	34·1	15·2	30	...	55	36	80	

COLUMBIAN I. OF WR. DRY DOCK CO.,

BALTIMORE.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1890	MAVERICK	Standard Oil Co.	New York	1561	1118	240·0	36·2	17·0	19	30	50	36	...	

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FORDES & C. DE LA MÉDIT.,

HAVRE.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1900	FRANCE-MARIE	A. Vimont & Cie....	Marseilles	2088	1078	250·0	40·0	23·5	...	...	...	...	...	Tank sailing vessel.
,,	JULES HENRY	,, ...	,,	2088	1078	250·0	40·0	23·5	...	...	...	...	...	,, ,, ,,

HAY & WRIGHT,

ALAMEDA, CAL.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1902	FULLERTON	Mission Trans. and Refining Co.	Los Angeles	1554	1494	235·0	42·5	19·5	...	...	...	...	...	Tank sailing vessel. Trading to Islands in Pacific.

BARROW S. B. CO.,

BARROW.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1887	HAINAUT	American Petroleum Co. ...	Rotterdam	1783	1734	248·8	40·3	22·2	...	...	...	...	...	Tank sailing vessel.

KJÖBENHAVNS FLYDK. SKBSV.,

COPENHAGEN.

Date.	Name.	Owner.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1903	No. 1	H. N. Anderson	Copenhagen	93	83	72·1	20·5	7·3	...	...	...	...	...	Tank sailing vessel.

LAPORTE & CIE.,

ROUEN.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1897	QUEVELLY	H. Prentout-Lebrond & E. Leroux	Rouen	3482	1710	322·0	45·5	24·2	...	...	...	...	...	Tank sailing vessel.

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CRAIG S. B. CO.,

Toledo, O.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1902	Toledo	Sun Oil Co.	Toledo	2277	1868	250·5	42·0	25·5	21	34	58	40	...	

C. KEILL & SONS,

Bristol.

Date.	Name.	Owner.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1881	Valeria	J. R. D. La Parra	Santander	347	152	120·4	23·2	9·7	10	15	24	18	160	Traded to English and Irish Ports.

BATH IRON WORKS,

Bath, Me.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1898	Winifred	Guffey Petroleum Co.	Galveston	2456	1455	283·5	42·2	22·1	20½	34	55	36	...	
1903	Shenango	„ „	Port Arthur	2365	1824	298·0	44·8	21·9	...	...	...	...	...	

W. LINDBERGS AKTIEB.,

Stockholm.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1893	W. Lindberg	Tagieff	Baku	1047	885	243·1	26·8	14·7	24⅜	4cy.	43	25⅜	...	

W. R. TRIGG & CO.,

Richmond, Va.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1904	Captain A. F. Lucas	Standard Oil Co.	New York	4188	...	360·0	50·0	28·5	25	41	68	42	...	

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DELAWARE RIVER I. S. B. & E. CO.,

CHESTER, PA.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1892	S. O. Co., No. 57	Standard Oil Co.	New York	1381	1310	241·5	37·0	18·0	...	...	...	...	...	Tank sailing vessel.
1893	S. O. Co., No. 58	,, ,, ...	,,	1644	1600	249·0	37·0	20·0	...	...	...	...	...	,, ,, ,,

UNION DRY DOCK CO.,

BUFFALO, N.Y.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1897	S. O. Co., No. 81	Standard Oil Co.	New York	1775	1402	254·0	40·5	23·0	...	..	...	...	...	Tank sailing vessel.

BURLEE DRY DOCK CO.,

PT. RICHMOND, N.Y.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1903	S. O. Co., No. 92	Standard Oil Co.	New York	3248	3044	302·4	43·3	28·6	...	...	...	...	...	Tank sailing vessel.

A. SEWALL & CO.,

BATH, ME.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1902	S. O. Co., No. 93	Standard Oil Co.	New York	2473	1857	280·1	45·4	23·4	...	...	...	...	...	Tank sailing vessel.

J. ROACH & SONS,

CHESTER, PA.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1888	STANDARD	Standard Oil Co.	New York	832	590	160·0	30·0	14·4	14	22	36	24	...	Converted into tank barge.

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SUPERIOR S. B. CO.,

West Superior, Wis.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1900	S. O. Co., No. 90	Standard Oil Co.	New York	1944	1762	246·6	42·0	21·2	...	...	...	...	...	Tank sailing vessel.
„	S. O. Co., No. 91	„ „	„	1944	1762	246·6	42·0	21·0	...	...	...	...	...	„ „ „

TOWNSEND-DOWNEY S. B. CO.,

Shooter Island, N.Y.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1903	S. O. Co., No. 94	Standard Oil Co.	New York	4167	3934	360·5	50·0	27·0	...	...	...	...	...	Tank sailing vessel.
„	S. O. Co., No. 95	„ „	„	4200	3900	360·5	50·0	27·0	...	...	...	...	...	„ „ „

J. L. THOMPSON & SONS,

Sunderland.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1889	Roma	Michigan SS. Co.	New York	2939	2164	316·0	40·6	20·8	23½	38	62	42	160	
„	Wildflower	SS. Wildflower (A. Suart) ...	London	2657	1745	300·0	40·2	18·8	24	39	64	42	150	Posted missing, February, 1896.

BARCLAY, CURLE & CO.,

Glasgow.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1883	Rosecrans	Matson Nav. Co.	SanFrancisco	2681	1719	335·0	38·2	27·2	36	...	68	48	...	Formerly *Columbia*.

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NAVAL CONSTRUCTION AND ARMAMENT CO., LTD.,

BARROW.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1893	HOUSATONIC (ex Northern Light) ...	Anglo-American Oil Co.... ...	London	3893	2552	347·4	45·6	27·2	26	42½	69	45	160	
,,	NORTHERN LIGHT (now Housatonic)	Northern Light S.S. Co.... ...	,,	3893	2552	347·4	45·6	27·2	26	42½	69	45	160	
1902	CALCUTTA	Anglo-American Oil Co.... ...	,,	1694	1578	248·8	40·2	21·9	...	...	...	...	...	Tank sailing vessel.

MAATS. FERGENOORD,

ROTTERDAM.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1902	J. B. AUG. KESSLER	Kon. N. M. tot Ex. van P.B. en N.I.	The Hague	5104	3197	377·0	50·0	21·7	24½	40	68	45	180	
1904	PERLAK	,, ,, ,, ,,	Pang.-Brand.	1864	1087	242·0	42·0	18·7	20½	33	55	36	180	

NEW YORK SHIPBUILDING CO.,

CAMDEN, N.J.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1901	J. M. GUFFEY	J. M. Guffey Petroleum Co. ...	Galveston	2520	1593	292·2	40·2	23·5	22	36	59	42	...	
1903	LARIMER	,, ,, ...	Port Arthur	3737	2396	352·5	46·4	19·2	25	42½	72	48	200	
,,	LIGONIER	,, ,, ...	Galveston	3737	2384	325·5	46·4	20·3	25	42½	72	48	...	

NED. STOMBS. MAATS.

ROTTERDAM.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1882	JULIA LUCKENBACH	Luckenbach Trans. & Wreck. Co.	New York	3100	1977	313·0	39·4	29·9	43	...	76	48	...	

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A. STEPHEN & SONS,

GLASGOW.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1881	CATANIA	J. M. Guffey & Co.	Galveston	2635	1932	315·1	35·7	22·6	35	2cy.	65	42	...	
1890	S. V. LUCKENBACH	Luckenbach Trans. & Wreck. Co.	New York	2674	1730	310·0	41·0	23·5	23	37	59	42	...	
1900	SANTA PAULA	Mission Trans. and Refining Co.	Los Angeles	650	632	183·1	30·3	16·4	...	...	...	...	...	Tank sailing vessel.

J. W. KLAWITTER,

DANZIG.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1903	CHAMID	F. M. & A. M. Rassuloff ...	Baku	1248	753	248·0	32·1	16·8	23⅜	...	41 9/16	23⅜	...	

W. PILE,

SUNDERLAND.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1866	CHARLES HOWARD (now Mineral)...	A. Suart	London	1304	849	249·0	30·1	16·9	27⅛	...	49⅛	40	65	Rebuilt in 1888. Burnt, November, 1895.

RICKMERS, R. R. & S. A. G.

GEESTEMUNDE.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1894	SABINE RICKMERS	Shell Transport and Trading Co.	Hong Kong	1026	690	200·0	30·6	20·9	17 3/8	28	44½	27⅝	...	

G. SEEBECK, A. G.,

BREMERHAVEN.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1898	SARUCHAN	R. Saruchkanoff	Baku	647	351	182·6	27·0	10·0	12	4cy.	20	16	...	

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R. CRAGGS & SONS, LTD.,

MIDDLESBROUGH.

Date.	Name.	Owners.	Port.	Register. Gross.	Net.	Dimensions. Length.	Breadth.	Depth.	Cylinders. H.P.	M.P.	L.P.	Stroke.	Pressure.	Remarks.
1888	CAROLINE ROB. DE MASSEY ...	R. Craggs & Sons	Stockton	1742	1130	256·3	37·0	17·9	20	33	54	36	160	Lost by collision, January, 1891.
1889	ATTILA (see Borneo)	J. M. Lennard & Sons	Middlesbro'	2141	1404	280·0	37·5	18·0	21	34	57	39	160	
1889	BORNEO (see Margaritha)	Deutsch-Amerik. Petro. Gest. ...	Geestemunde	2141	1404	280·0	37·5	18·0	21	34	57	39	160	
1889	MARGARITHA(ex Borneo)	Margaritha Dmpfsch. Gest. ...	Hamburg	2115	1333	280·0	37·5	18·0	21	34	57	39	160	
1892	HENRI RIETH	Lennard's Carrying Co., Ltd. ...	Middlesbro'	2265	1474	280·0	38·5	18·0	21½	36	59	39	160	
1892	HARRY WADSWORTH (ex Henri Rieth)	Do. do. ...	,,	2265	1474	280·0	38·5	18·0	21½	36	59	39	160	
1901	METEOR	Rus. Steam Nav. and Tradg. Co.	Odessa	4259	2546	349·6	47·0	21·1	25	40	68	48	180	

DELAWARE RIVER CO.,

CHESTER, PA.

Date.	Name.	Owners.	Port.	Register. Gross.	Net.	Dimensions. Length.	Breadth.	Depth.	Cylinders. H.P.	M.P.	L.P.	Stroke.	Pressure.	Remarks.
1892	S. O. Co., No. 57	Standard Oil Co.	New York	1381	1310	241·5	37·0	18·0	...	...	...	...	...	Tank sailing vessel.
1893	S. O. Co., No. 58	,, ,, ...	,,	1644	1600	249·0	37·0	20·0	...	...	...	...	...	,, ,,
1898	ATLAS	,, ,, ...	,,	1942	1243	248·0	40·1	22·5	21	34	56	42	...	

BERTRAM, HASWELL & CO.,

SUNDERLAND.

Date.	Name.	Owners.	Port.	Register. Gross.	Net.	Dimensions. Length.	Breadth.	Depth.	Cylinders. H.P.	M.P.	L.P.	Stroke.	Pressure.	Remarks.
1880	FERGUSONS	J. M. Lennard & Sons	Middlesbro'	1504	937	250·0	34·5	18·8	30	...	57	36	90	First steamer to carry bulk oil. Explosion, December, 1889. Total loss.
1883	CHIGWELL	Shell Transport and Trading Co.	London	1824	1192	258·8	36·2	18·7	33	...	61	33	80	

ACT. GES. WESER,

BREMEN.

Date.	Name.	Owners.	Port.	Register. Gross.	Net.	Dimensions. Length.	Breadth.	Depth.	Cylinders. H.P.	M.P.	L.P.	Stroke.	Pressure.	Remarks.
1897	ANNA	M. Gukasoff	Baku	1048	528	223·9	31·5	16·5	17¾	...	31½	21¾	...	

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LINDHOLMENS M. V.

GOTHENBURG.

Date.	Name.	Owners.	Port.	Register. Gross.	Net.	Dimensions. Length.	Breadth.	Depth.	Cylinders. H.P.	M.P.	L.P.	Stroke.	Pressure.	Remarks.
1897	ASSA DADASCHEFF	A. A. Dadascheff	Baku	1293	942	257·0	32·8	16·5	19	4cy.	40	24	...	
1899	SULEIMAN OSEINOFF	Mamed Bagir Oseinoff	Astrakhan	2000	...	284·0	32·2	18·8	20	4cy.	40	24	...	
1902	ALEKBER OSEINOFF	„ „ „	„	2000	...	284·0	32·2	18·8	20	...	40	24	...	
1903	HADSCHI H. AGA DADASCHEFF ...	A. A. Dadascheff	Baku	...	...	255·0	32·0	17·7	20	...	40	24	...	
„	SAMED AGA	Asim Iskenderoff	Astrakhan	1500	...	222·6	31·0	18·0	21	...	43	27	...	
„	AUGUSTA	Sydsvenska Petroleums Aktieb.	Malmö	212	202	98·4	22·0	11·8	...	...	...	...	...	Tank sailing vessel.

KOCKUMS M.V. AKTIEB.,

MALMÖ.

Date.	Name.	Owners.	Port.	Register. Gross.	Net.	Dimensions. Length.	Breadth.	Depth.	Cylinders. H.P.	M.P.	L.P.	Stroke.	Pressure.	Remarks.
1893	ALI DADASCHEFF	A. A. Dadascheff	Baku	541	395	150·5	27·7	14·0	$20\frac{7}{8}$	...	38	$23\frac{5}{16}$	...	
„	PUSCHKIN	M. M. Berne & Co.	„	1043	852	246·0	27·7	18·5	$20\frac{7}{8}$	2cy.	38	$23\frac{5}{16}$	...	
1894	PASCHA DADASCHEFF	A. A. Dadascheff	„	1054	865	246·0	27·7	17·3	$20\frac{7}{8}$	4cy.	38	$23\frac{5}{16}$	...	
1897	ADSCHI AGA	Asim Iskenderoff	Astrakhan	1019	747	218·0	30·0	18·6	$20\frac{7}{8}$	...	38	$23\frac{5}{16}$	...	
1899	MIRZA AGA	„ „	„	792	...	180·0	30·0	17·0	$20\frac{1}{2}$	2cy.	41	$25\frac{9}{16}$	...	

ODERWERKE ACT. GEST.

STETTIN AND GRABOW.

Date.	Name.	Owners.	Port.	Register. Gross.	Net.	Dimensions. Length.	Breadth.	Depth.	Cylinders. H.P.	M.P.	L.P.	Stroke.	Pressure.	Remarks.
1897	AGA SELIM	Sadikoff	Baku	698	420	180·7	29·6	14·4	$18\frac{1}{2}$	...	$33\frac{1}{2}$	$23\frac{1}{2}$	...	
„	MAMED AGA	Mamedoff & Aslanoff	„	536	310	151·7	28·1	13·8	$17\frac{1}{2}$	...	$31\frac{1}{2}$	$21\frac{1}{16}$	...	
1898	KARLSRUHE	Ges. für B. S. & C. Fabr. vorm G. S.	Stettin	637	371	173·2	28·5	13·7	$15\frac{3}{4}$	...	$27\frac{1}{2}$	$15\frac{5}{16}$	...	

SUNDERLAND SHIPBUILDING CO.,

SUNDERLAND.

Date.	Name.	Owners.	Port.	Register. Gross.	Net.	Dimensions. Length.	Breadth.	Depth.	Cylinders. H.P.	M.P.	L.P.	Stroke.	Pressure.	Remarks.
1893	ATLAND (ex Marquis Scicluna) ...	A. Broström	Gothenburg	1599	1024	260·0	36·2	18·6	32	...	62	40	80	

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C. OLSSEN GAMLA,

LÖDÖSE.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Lngth.	Dimensions. Brdth.	Dimensions. Dpth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1897	DANA	Rederiaktieb Dana	Carlstad	207	129	98·4	22·6	10·7	10	2cy.	18	14	...	

STETTINER MASCHINENB ACT. GEST. VULCAN,

BREDOWA AND STETTIN.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1893	DEUTSCHLAND	Deutsch-Amerik. Petro. Gest. ...	Hamburg	3710	2353	339·0	43·8	29·6	$23\frac{3}{4}$	$40\frac{1}{8}$	$64\frac{1}{8}$	$49\frac{1}{8}$	...	
1894	EXCELSIOR	,, ,, ...	,,	3710	2361	339·1	43·7	29·6	24	40	64	49	...	
,,	WASHINGTON	,, ,, ...	,,	4171	2659	354·3	45·1	30·1	24	40	64	49	...	

NEDERL. SCHPS. MAATS.,

AMSTERDAM.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1901	DORDT	Dordtsch Petroleum Maats. ...	Surabaya	191	65	118·0	21·0	9·5	$12\frac{9}{10}$	2cy.	$20\frac{1}{8}$	$17\frac{7}{10}$	...	
1904	SULTAN VAN KOETEI	Royal Dutch Co.	Amsterdam	1850	...	239·2	42·0	19·9	...	...	...	...	...	
1905	PALEMBANG	,, ,, ...	Pang.-Brand.	1856	1062	241·0	41·9	18·7	21	$32\frac{3}{4}$	55	36	...	

ILIFF, MORMSLY & CO.,

SUNDERLAND.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1870	EZIO (ex Titian)	F. F. Piaggio	Genoa	1249	810	231·0	31·1	23·6	17	27	45	30	70	
1870	TITIAN (now Ezio)	P. T. & S. Co. (A. Suart) ...	London	1249	810	231·0	31·1	23·6	27	...	52	30	...	

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LOBNITZ & CO.,

RENFREW.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks
1883	ATTAKA (ex Sublime)	Shell Transport and Trading Co.	Colombo	310	140	134·0	25·6	15·8	14	...	28	24	...	These small tank steamers carry oil to different ports in the Far East. They form part of the auxiliary fleet of the Shell Company, and will in future be worked under the Royal Dutch and Shell Combination.
1884	OUADY	,, ,, ,,	Mo'ara Djawa	364	164	134·7	25·4	13·1	14	4cy.	28	24	...	
,,	SAID	,, ,, ,,	Colombo	344	170	133·7	25·2	10·3	14	4cy.	28	24	...	
,,	SERAPIUM	,, ,, ,,	Balik-Papan	368	166	134·8	25·2	13·1	14	...	28	24	...	
,,	SUEZ	,, ,, ,,	,,	365	164	134·1	25·0	11·1	14	...	28	24	...	
,,	TIMSAH	,, ,, ,,	London	349	134	134·0	25·3	11·0	14	4cy.	28	24	...	
,,	RHAMSES	,, ,, ,,	Balik-Papan	365	164	134·1	25·0	11·1	14	...	28	24	...	
,,	TOUSSOUM	,, ,, ,,	Mo'ara Djawa	362	163	134·8	25·1	13·1	14	...	28	24	...	

J. C. TECKLENBORG,

GEESTEMUNDE.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1894	AUGUST KORFF	Deutsch-Amerik. Petroleum Gest.	Hamburg	4055	2602	353·1	45·4	22·1	25 9/16	40 1/8	67	45 1/4	...	

RIJKEE & CO.,

ROTTERDAM.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1896	BESITANG	Royal Dutch Co.	Pang.-Brand.	417	274	150·5	24·0	10·5	16	2cy.	29	21	...	
1897	BABALAN	,, ,, ...	,,	536	339	185·5	25·9	10·3	12 1/2	20	33 3/4	21	175	
,,	HALABAN	,, ,, ...	,,	536	339	185·5	25·9	10·3	12 1/2	20	33 3/4	21	175	

FURNESS, WITHY & CO., LTD.,

WEST HARTLEPOOL.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1903	SEMINOLE	Anglo-American Oil Co.... ...	Newcastle	5864	3797	400·6	52·2	30·8	28	46	77	48	180	Originally the property of the builders.

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CIE. GÉNÉRALE TRANSATLANTIQUE,

St. Nazaire.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1893	Alice Isabelle	P. Lesourd & Fils	Sables d'Olo'e	612	501	181·7	31·6	17·3	...	...	...	...	...	Tank sailing vessel.

THAMES IRONWORKS, LTD.,

London.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1893	Coaltar	Burt, Boulton & Haywood ...	London	219	195	109·0	24·0	12·8	...	...	...	...	...	Tank sailing vessel.

T. ROYDON & SONS,

Liverpool.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1879	Conemaugh (ex Lornty)	J. M. Guffey Petroleum Co. ...	Galveston	1774	1714	154·0	40·5	24·3	...	...	...	...	...	Tank sailing vessel.

HARLAM & HOLLINGSWORTH CO.,

Wilmington, Del.

Date.	Name.	Owners.	Port.	Register. Gross.	Register. Net.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Cylinders. H.P.	Cylinders. M.P.	Cylinders. L.P.	Stroke.	Pressure.	Remarks.
1875	Conneaut (ex Lone Star)	J. M. Guffey Petroleum Co. ...	Galveston	1690	1620	280·0	38·1	20·2	...	...	...	...	...	Tank sailing vessel.

Particulars of vessels building are given in Chapter XIV.

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IN this work bulk oil-carrying sailers are frequently referred to. They have never been so numerous as the case oil vessels. In 1892 those carrying bulk oil from the United States were—

Name.	Oil-carrying Capacity.		Dimensions of Vessel. (English feet.)			Flag.
	Gallons.	Tons.	Length.	Beam.	Depth.	
Einar	230,000	665	154	33	19	Norwegian.
Hainaut	870,000	2,525	249	40	22	Belgian.
Patagonia	500,000	1,450	190	38	22	Norwegian.
Rolf	430,000	1,250	201	36	23	Do.
Unionen	875,000	2,530	249	40	22	Do.
Ville de Dieppe ...	641,000	1,860	217	36	21	French.

Several have been lost. The Standard lost the case oil carrier *Nonpereil* in the autumn of 1900. Being a new vessel, nothing definite was known about her trim, and when at sea it was found she was tender. When only a few days out she encountered a south-west hurricane, and, her cargo shifting, she went over on to her beam ends. The crew were taken off by the steamer *Glenfoil*. She was twice picked up and cast off by steamers, and the wreck charts of the Atlantic showed that she drifted thousands of miles. The end of the *Nonpereil* is one of those numerous blanks which we find in the history of Atlantic derelicts.

* * *

The four-masted case oil sailer *Sinda*, 3,000 tons, homeward bound to New York from Japan, ran into a fog off the New Jersey coast, struck the rocks, and was lost.

* * *

The four-masted steel sailing ship *Astral* was the first oil-carrying sailer owned by the Standard to fly the American flag. She carries 1,500,000 gallons of case oil.

* * *

The Standard ship *Atlas* is a record maker in the New York and Far Eastern oil trade. She has made the run from Hong Kong in ninety days. Like the *Astral* and *Acme*, she was built by Sewell, Bath, Maine. It was a Standard sailing vessel, the *Drumeltan*, which made a record from New York to the Cape and back. She did the round voyage in 125 days.

* * *

The *Thomas W. Lawson* and *W. L. Douglass* are the two largest oil-carrying schooners afloat. The *Lawson* has seven masts and the *Douglass* six. The *Douglass* was equipped with oil tanks at the Morse Iron Works, South Brooklyn, while the *Lawson* was prepared for the oil-carrying trade at the Newport News shipyard. The following are the chief particulars of the *Lawson*—Length over all, 395 ft.; moulded depth, 34 ft. 5 ins.; displacement, 10,000 tons; deadweight cargo capacity, 7,500 tons; height mainmast, step to truck, 182 ft.; total sail area, 40,617 sq. ft. Before they started to carry oil in bulk they were employed in the coal trade.

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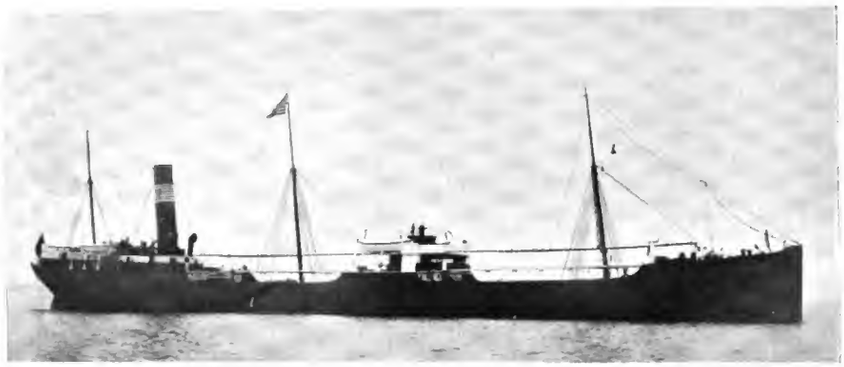
THE tank sailer *Sunlight* (on the right) is small compared with the huge tank and case oil sailing vessels which the Standard and Anglo-American Companies jointly run from America to the Far East. In some respects she is unique.

She is owned by Messrs. Lever Bros., the world-famous soap concern, and was built by Messrs. Napier & Miller, on the Clyde, for the purpose of carrying different kinds of vegetable oils in tanks between Sydney and Liverpool. The photo was taken as she was towed down the Clyde on her maiden voyage, and she is now homeward bound from Australia with her first cargo. She is 230 ft. in length, 36 ft. wide, and has a registered tonnage of some 1,300 tons, with an oil capacity of 2,150 tons.



The *Aureole* (1895) and three other tank steamers—*Duffield* (1893), *Oilfield* (1896), and *Bloomfield* (1899)—were built by the Tyne Iron Shipbuilding Company, Ltd., of Willington Quay-on-Tyne, for Messrs. Hunting & Son (Northern Petroleum Tank Steamship Company), of Newcastle.

The *San Cristobal* was built in 1906 by Messrs. Armstrong, Whitworth & Co. for Sir Weetman Pearson's Mexican Oil Company, of London and Mexico City. She recently ran from Texas to Antwerp for the Continental Petroleum Company, Ltd., although she is specially designed to carry the output of the Mexican fields when her owners start to export oil. She is a trunk type of steamer: in many respects she is like the Shell oil-carrier *Trigonia*, the first of her class to run in the oil trade.

[*To face p. 104.*

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CHAPTER X.

A Tale of Heroism and a Chapter of Casualties.

IN petroleum shipping annals I can find no nobler act of heroism than the one which cost Captain Walker his life. A native of Dalkieth, N.B., he served his apprenticeship in the sailing ship *Sancho*, owned by Messrs. John Dent & Co., of Blyth. In 1903 he was in command of the small Shell steamer *Geneffe*, running in the oil-carrying trade in the Far East. On November 10th in that year the *Geneffe* was discharging a cargo of benzine at Palembang, Sumatra. Work was proceeding quietly when one of the pipes suddenly burst and released huge volumes of benzine vapour, which, coming in contact with the galley fire, caused a tremendous explosion. There was a flash of flame, and before anyone could realise what had happened the after-deck was covered with blazing benzine. Men made for the shore, but there were three who remained to fight the flames; these were Captain Walker, Mr. Cameron, his chief engineer, and the chief engineer of the *Attaka*, another small tank steamer belonging to the same owners. The two engineers were caught by the flames. The chief of the *Attaka* plunged overboard and was drowned. Mr. Cameron was so badly scorched that he fell on the deck. Captain Walker, dashing through the flames, picked him up and dropped him into the water. In this way he gallantly saved the life of his chief engineer. This noble act performed, Captain Walker did his duty as the master of the doomed vessel. He gave orders to let go the shore hawsers. These were already on fire, and when they parted the *Geneffe* drifted clear of the wharf. Rushing forward, he attempted to drop the anchor, the work of four men, and actually got it over the side, but before he had time to let go the flames had beaten him, were upon him, in fact, and he was compelled to leap overboard. As he disappeared over the side the decks blew up, and the ship and her brave commander went down together.

The story of Captain Walker's heroic deeds—for, as I have shown, he performed more than one—should live for all time in the history of an industry which is not barren of thrilling incidents at sea and acts of personal bravery.

* * * * *

Naturally, during a period of thirty-five years, tank steamers have met with all kinds of disasters. The marine branch of the industry has its list of casualties. It is a surprisingly short list, and if it were not for the accidents of twenty years ago, and the four serious ones of the present year (those which were directly due to inexperience and carelessness), it could very well be put forward as evidence of the safety of the bulk oil transport system. It is necessary that I should mention these shipping disasters, but there is no reason why I should go beyond brief summaries of carefully collected information concerning a few typical cases from which lessons may be drawn by those who are responsible for the control and navigation of the oil carriers of the present time.

One of the earliest disasters on the Atlantic happened to the oil-carrying sailer *James Fish*. She sailed from New York on September 13th, 1876, with a cargo of refined petroleum, spirits of turpentine, lubricating oil and wax, bound to London. On September 27th, in a heavy squall and thunderstorm, she was struck by lightning, smoke being immediately afterwards discovered coming up the chain lockers. The force pump was set to work to keep it down, but, finding the smoke increasing, the crew removed the fore hatches and immediately replaced them. They kept the pumps and buckets working, forcing water down the chain locker hatch, and as the smoke still increased, they removed the main hatches, which were at once replaced. At 8 p.m. all hands took to the boats, fearing an explosion, and hung round the ship all night, and at 4 a.m. they

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were picked up by the Italian barque *Clementa S.* At 5 a.m. the captain returned on board in his own boat, and found the fire was out; at 6.30 a.m. all hands returned and straightened her up. Towards the end of the day the weather moderated, when all necessary sail was made, and the pumps were carefully attended to, large quantities of spirits of turpentine and oil coming up with the water. When off Dungeness a pilot came on board, and, with the assistance of a steam tug, the vessel reached the Thames. On October 19th, when discharging, the men found barrels scorched and badly burned, some of them being also empty, but when she finished discharging on October 28th, the cargo turned out correct with five barrels over.

The *Aurora* (1,808 tons), laden with 59,332 cases of kerosene, was moored at Matiabrooj, in the Hooghly, and had discharged about 32,310 cases on February 20th, 1884. A fire was seen issuing from the port lazarette hatch, and spread very rapidly, the vessel being quickly in flames, which rose to a height of from 50 to 60 ft. The heat was too great to allow her to be approached; it was impossible to do more than keep her from getting adrift while the tide was running up the river, and she could not be beached. The ebb tide gradually forced the vessel down, and partially cleared the wreckage, when she took the bank and stuck hard and fast. By degrees she burned down to the water's edge, and then, as she settled down and water flowed into the burning hull, a floating mass of burning oil gradually spread out and created alarm for the shipping in the river. Fortunately, the wind was in a favourable direction, and by the exertions of the Harbour Master and the police the fire and floating cases of oil were kept back. In the official report it is stated that had it been a strong flood tide, all efforts would have been in vain, and the floating mass of fire and smoke would have been amongst the shipping in about a quarter of an hour. A strong flood tide and a westerly wind would have destroyed the whole of the shipping in the port. As a matter of fact, little destruction was done; some straw stacks, a Harbour Master's hulk, and the police boat were destroyed, but no lives were lost. The fire burnt for about nine hours before the vessel sank.

The Commissioner of Police made the following observations:

"Much as the accident is to be regretted, it illustrated most opportunely the extreme danger to the port involved in allowing petroleum to be unloaded within reach of the shipping. It shows that after a vessel stored with petroleum has caught fire it is extremely difficult to exercise any control over her movements, and if she were to get adrift on a flood tide there is no limit to the disaster which might ensue, especially if she sank after drifting far into the port. But, even if controlled and retained at Matiabrooj, as in the present instance, the river must become a sheet of flame when she at last sinks. In the present case, although the ship had discharged more than half her cargo, she burnt for nearly nine hours before sinking, and the oil which remained caused a fire on the surface of the river for half-an-hour. Had the wind been a point more to the south, and had the quantity of burning oil in the vessel when she sank been larger, it is difficult to see how the shipping in Garden Reach could have been saved. It must be admitted that the distance of Matiabrooj diminishes the risk, and in the present instance (owing to the wind driving the flames into the left bank, and also to the fire not lasting on the water for a longer period) proved the salvation of the port; but looking to the stupendous nature of the catastrophe which might occur, with a very possible combination of wind and tide, and especially to the rapid development of the petroleum trade, it becomes a very serious question whether the safety of the port does not demand that either Port Canning or Diamond Harbour should be fixed upon as the petroleum depôt of Calcutta."

In 1886 the *Petriana* had just discharged a cargo of Russian kerosene when an explosion occurred ir one of the oil tanks. The accident was due to the rapid combustion of petroleum spray. Ten lives were lost.

On the *Ville de Calais* (1888) an empty tank, from which American crude had just been discharged, was being filled with water ballast, when a mixture of air and petroleum vapour became ignited and an explosion destroyed the ship. Several persons were killed, and damage was done to property. The *Ville de Calais* was an extremely good specimen of an oil-carrying vessel in her day. She was lost through the ignorance of those on board, and the same may be said of the *Austral*, which was destroyed by an explosion while lying in Sydney Harbour.

The *Wildflower*, built at Sunderland (1889), to carry petroleum in bulk, had six cargo and five water ballast tanks. The cargo tanks extended from the skin up to the lower deck; the sides of the ship formed the sides of the tanks, and each tank had an

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expansion tank with a manhole door. These tanks were also capable of being used for water ballast.

She loaded oil at Philadelphia, and discharged at Rouen, the work finishing on January 4th, 1889. The tanks were pumped out as far as possible until the pumps ceased drawing. There was left in No. 1 tank about 6½ in., in No. 2 tank about 2 in., in No. 3 tank about 1 in., in No. 4 tank about 5 in., in No. 5 tank about 15 in., and in No. 6 tank about 7½ in. . . . On January 8th, the vessel got under way, and was moored at the buoys off the Manor Quay, on the north side of the Wear, with her head up stream. As soon as she was moored the master gave directions to the chief engineer to straighten the ship, which had a list to port. He gave no particular directions as to draining the tanks, but left it to his discretion. By direction of the chief engineer, pumping from the cargo tanks commenced at 9.30 a.m., the forward pump of the two in the pump room, which discharged into the pipe on the starboard side amidships, being used. The tide had been ebb, but a considerable eddy was formed by the set of the tide just below the end of the Manor Quay.

Mr. James Brown, master of a ferry boat, stated that from daylight he observed oil floating on the surface of the water, that it was very thick in the bay or bight at the north ferry landing and around the *Parkfield*, that a "fearful" smell was given off from it, and that his passengers complained of it all the morning. He described the oil as being of a yellowish green colour. He also observed that the rivetters were using forges on board the *Parkfield*. At 11.45 he left the Monkwearmouth side of the river and passed close under the bows of the *Parkfield*. Looking up the river, to see if the channel was clear, he observed a small body of smoke and flame, about the size of an ordinary house fire, upon the surface of the water, not more than 4 or 5 ft. from the starboard side of the *Parkfield*, in the way of the after-part of the engine room, and about 60 ft. from his vessel.

The area of the fire extended, and the smoke and flames rushed up into the air and swept by the quarter of the *Parkfield* to the westward, being level with the rails of that ship. The flames, carried up by the tide, caught a keel lying at the quay between the *Deronda* and the *Parkfield*. They scorched the quarter of the *Parkfield*, but she was saved from serious damage by being hauled ahead by a steam winch on the quay. They passed astern of the *Parkfield*, and enveloped the lighter, burning it badly. By this time they were rising to a great height, and rushed over the bows of the *Deronda*. There was a boat and a raft of timber between the *Deronda* and the quay. Some of the workmen on the *Deronda* dropped into the boat, and got safely to the raft; but two boiler-smiths were left hanging to a rope over the steamer's port quarter. Another boat was sent to take these two men on board. The flames swept round the vessel's stern from the starboard side and enveloped the boat. The two men and the men at the oars jumped overboard, two of them being saved by getting hold of boathooks held towards them from the raft; but the third man, John Thompson, was drowned before assistance could be rendered. The surface of the water where he sank was a mass of flame.

The fire was extinguished on the *Deronda* by a hose from the quay and the police hose, but the vessel was considerably damaged. The flames then enveloped the tug *Earl of Dumfries*, destroying the whole of the bulwarks, paddle-cases, mast, bridge and wheel-screen, engine house, and a portion of the cabin.

The flames spread to the *Douglas*. 'A witness who was on board this vessel, and saw the commencement of the fire, described it as being no larger than his cap, but it increased in size very rapidly. From the *Douglas* the fire passed to the *Wildflower*, and was so fierce that twenty-seven plates in the latter vessel were badly buckled. The fire was extinguished partly by burning itself out and partly by the water played upon it by various engines.

The *Lux* (1891) was lost in the Doro channel, Grecian Archipelago. After discharging a cargo of Russian kerosene a fire broke out in the bilges. The vessel was abandoned, and during the night the officers heard two reports of explosions. She drove ashore and became a total wreck.

The *Tancarville*, in 1891, after discharging a cargo of oil at Havre, dry docked at Newport, where some oil got into a ballast tank in which a workman was cutting a thread to replace a defective rivet. A tongue of flame issued from the hold, and then a very violent explosion occurred. Lives were lost. The accident was due to the ignition of a mixture of air and petroleum vapour in the ballast tank.

While discharging at Braye, near Bordeaux, in 1892, the *Petrolea* was struck by lightning, and an explosion resulted in the loss of several lives.

There have been accidents on the other side of the Atlantic. I have already referred to the burning of the British-owned steamer *Bakuin* in Callao Bay, Peru, and the whaleback oil-carrier *City of Everett*,

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one of the first steamers placed in the Texas oil trade, at Port Arthur.

The oil-carrying steamer *Progreso* was practically torn in two at San Francisco, and eleven men were killed and many more injured. The oil was a mixed Coalinga oil, exceedingly volatile and explosive, and flashed at 101°. Fire-Marshal Towe said :—

"Its explosive characteristics are apparent, the smell alone being sufficient to warn anyone from putting a lighted match to even a small quantity. If the oil is a true sample of what was put on board the *Progreso*, the cause of the explosion is at once apparent. The gas in the tank would explode immediately if an exposed light were brought in contact with it. What the light was in the case of the *Progreso* is not, and probably never will be, known. Undoubtedly the man who held it perished; but, say those on the spot, the accident would never have occurred if proper and safe oil had been placed in the tank."

One cannot very well deal with this subject without recalling the mishap to the Shell tank steamer *Bulysses* and the destruction of the same company's steamer *Nerite* in the Suez Canal. On March 13th, 1902, during a sandstorm, the *Bulysses* took the ground badly in section Kabret (Great Bitter Lakes). The Canal Company's tank vessel *Progress* immediately went alongside for the purpose of taking in some of the oil cargo of the *Bulysses* and transferring it to the storage tanks on the banks of the canal. On the 15th the *Nerite* steamed close to the *Bulysses* to assist in lightening her. It was anticipated that when as much oil as was considered safe had been put into the *Nerite*, she would proceed to Suez and discharge part of her cargo, and then return to the *Bulysses* to take so much more of her oil out as was necessary to enable her to float; but instead of this, those on board the *Nerite*, in their great desire to assist the sister ship, took far more oil than was safe, with the result that every space in the ship was full. Expansion of the cargo burst the after cofferdam, let the oil freely into the stokehold, and set her on fire. In this case, where men had to act in an emergency, there was an unpreventable violation of one of the canons of the safe carriage of petroleum, which is that under no circumstances shall petroleum, forming the cargo, be allowed to enter the engine or boiler room.*

Two of the cases I have given—those of the *Nerite* and the *City of Everett*—conclusively prove that a modern tank steamer in flames, provided she has not been holed, is no more dangerous to shipping than a cotton-carrying steamer on fire. When in flames a tank steamer will not blow up. The *Nerite* acted as a lamp until the last drop of her huge liquid cargo had been consumed.

The industry also has its marine mysteries. There is the one of the *S. V. Luckenbach*, lost on a voyage from Port Arthur, Texas, to Marcus Hook, with 26,000 barrels of crude petroleum. A bottle on the beach contained this message—"This is thrown overboard from steamship *S. V. Luckenbach*, bound from Sabine Pass to Philadelphia with cargo of oil, on fire. Ship abandoned about 500 miles south-east of Hatteras. Been working two days and nights to extinguish flames.—Signed, J. S. Flint, fireman, April, 1903."

Coming to the present year, we have a record list of serious casualties; this includes three total losses—the *Lucifer*, *Silverlip* and *Sophie*—totalling, in money value, nearly quarter of a million, and several cases of serious damage.

In March the Union Oil Company's *Santa Rita* discharged large quantities of fuel oil into San Francisco Bay, and a spark from a locomotive set fire to the oil on the water, with the result that the flames reached the *Beieldieu*, owned by the Société Nouvelle d'Armement of France.

There was a curious accident to one of the Pacific Oil traders a few months ago. While the vessel was off the coast the pumps were employed to clear some of her tanks of water ballast, when, by an extraordinary mistake, they started to discharge large quantities of oil cargo into the sea.

The first serious loss this year was the Bear Creek Company's *Lucifer*. Carrying kerosene, she left New York for Dublin, on April 5th, under the command of Capt. Wilson. When four days out a leak was discovered under the stokehold. The steam pumps were started, and Capt. Wilson felt confident his men could discover and stop it. The water, however, gradually rose in the stokehold.

* The lessons of this disaster do not finish with the loss of the *Nerite*. The Shell Company built another *Nerite*, and, curiously enough, it was this steamer which shortly afterwards demonstrated that, although her predecessor failed in the case of the *Bulysses*, it is possible for a tank steamer to safely remove oil cargo from a stranded vessel and enable her to float. The *Volute* was ashore in the Yang-tsze river, below Hankau, on November, 1906, and as the water was falling in the river the *Nerite* was sent to pump out some of her cargo of 5,200 tons of Borneo kerosene. She did this, and in other ways assisted the *Volute* to get off and return to Hankau.

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On April 12th, a heavy gale sprang up, and the leak increased, filling the stokehold and engine room, putting out the fires, and rendering the vessel helpless. The pumps were kept going by means of a donkey boiler on deck, but the water gained so rapidly that the crew had to assist by baling with buckets.

Over eight hundred tons of oil were pumped into the sea, but, although the *Lucifer* was lightened, seas swept her deck. Seven days after she had sprung a leak, the steamer *Sagami* hove in sight; but the seas were too boisterous to attempt a rescue, and Capt. Wilson signalled that he thought he could keep his vessel afloat till daybreak. The *Sagami* consented to stand by, and at daybreak the captain called for volunteers to man one of the boats. Mr. Wallace, third officer, and five seamen responded and performed one of those acts of heroism which are so common in the Atlantic. The work of getting alongside the disabled tanker was hazardous, for it was feared that the boat would be smashed against the steamer, over whose decks waves were sweeping.

A boatload of the *Lucifer's* crew were safely transferred to the *Sagami*, and a second trip was made, again successfully, amid the cheers of their shipmates. One of the *Lucifer's* own boats took off the remainder of the crew. Though the men lost all their belongings, they took off three of the ship's cats, and shortly afterwards the *Lucifer* was seen to go down stern first.

One survivor, a Cornishman, in the course of a graphic story, said—"We look upon Mr. Wallace, of the *Sagami*, as a hero, for only those who saw the seas running can realise what risk he ran in launching a boat." It is also known that Capt. Wilson and his own men did their duty; they worked with the utmost bravery to keep the waterlogged steamer afloat, and only left her when there was absolutely no hope of ever getting her to port.

The next serious disaster was the blowing up of the *Silverlip* in the Bay of Biscay. This first-class but unfortunate tank steamer was a sister ship of the *Goldmouth*, and the two, both built on the Tyne, were the largest vessels of the Shell fleet.

Commanded by Captain Nathaniel Hocken (fifteen years' experience in Shell steamers and seven years' in carrying benzine cargoes), the *Silverlip* loaded benzine at Balak-Papan and Singapore, passed through the Suez Canal (under the new regulations relating to the transit of benzine), and got about halfway across the Bay of Biscay when she was destroyed by a series of explosions.

She had seven holds for carrying oil. There was a cofferdam right aft on the forward side of the engine-room space. Reaching up to the upper deck, it shut off the engine-room compartment from No. 1 tank. Forward of No. 3 hold there was the pump room and another cofferdam, which did not come up as far as the main deck. Forward of No. 7 hold was another cofferdam, which extended to the upper deck. Each of these was fitted with hatchways and expansion tanks. The tanks were each divided longitudinally by a bulkhead, so that they were really double tanks. The expansion tanks were carried up to the upper deck, and Nos. 3 and 4 holds up to the bridge deck. On the top of the expansion tanks was a screw plug about 7½ in. in diameter. There were gas cocks fitted into each hatch for the purpose of relieving the tanks of vapour. Communication between officers and crew was obtained by means of a portable gangway.

The engineers were berthed right aft on the same deck, and the galley was situated right aft. The ship was lit by electricity, and there were strict regulations against smoking, which was allowed aft, but not on the decks.

In March this year the vessel was at Balak-Papan, and took in 2,576 tons of benzine. This was shipped in Nos. 2 and 3 holds or tanks. She proceeded to Singapore, and loaded 5,841 tons of the same kind of spirit. The specific gravity of the benzine varied from ·747 to ·760. The tanks were full of benzine, but there was no cargo in the 'tween decks.

She left Singapore on March 25th with a crew of fifty-three hands, bound for St. Catherine's Point (I.W.) for orders. Off Finisterre on April 30th she encountered tempestuous weather, and the temperature fell to about 45°. On May 1st she was about 240 miles north-east of Finisterre. She was proceeding at full speed, steering about N.E. ¼ N. There was a strong wind from the north-west, so that she had the wind on her port side.

It was discovered that the benzine in Nos. 3 and 4 tanks had contracted, and the master ordered the chief officer to press them up with salt water. The chief officer proceeded to do this. The screw cap was taken off the expansion on the starboard side of No. 4 hatch. The gas cocks on the starboard side were also opened to get rid of the vapour. A hose was laid along the deck to the expansion tank, and water was pumped down into No. 4 hold on the starboard side. Nothing whatever was done with No. 3. Pumping went on for some time, and at about 1.50 p.m. the chief officer went to his cabin. At this

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time the carpenter (Creekling) was attending to the hose on the starboard side, and the boatswain (Grant) was engaged in sounding No. 4 hold. There were two firemen on the 'tween deck under the bridge deck abreast of No. 3 hatch on the starboard side, painting or scraping a bulkhead. The second officer was on the bridge, and a quartermaster at the wheel. Other members of the crew were right forward and right aft.

Shortly after the chief officer had gone to his cabin a terrific explosion occurred in the neighbourhood of No. 4 hatch. Other explosions followed. The first explosion killed the carpenter and the boatswain and the two firemen (Munro, a Scotchman, and Abbas, a Turk), who were working under the bridge deck. A later explosion killed the chief engineer.

The master, who was in his cabin, rushed through the flames aft, and, with the assistance of some of the other officers and the crew, boats were got out and taken to the forward part of the ship. The whole of the amidships section of the vessel was blazing. Those in the forward part of the ship were taken off, and the boats pulled away. The survivors were picked up by the steamer *Westgate* and taken to Plymouth.

Capt. Hocken stated at the official inquiry that the only flame was in the galley and the stokehold, the vessel being lighted by electricity. Referring to the regulations as to smoking and the non-use of matches, he said that when in the Suez Canal matches were supposed to be taken from the men. He once logged a fireman for smoking.*

He was in his room when he heard the first explosion. He rushed out and found flames on all quarters and the boats on the bridge on fire. He gave orders, and managed to get the living part of the crew off the ship. There were five men missing. At the time of the explosion there was no naked light on the deck nor in the galley, and "the only conclusion he could come to was that a man must have struck a match to have a smoke and that it ignited gas near No. 4 hold." He had, however, never detected gas there before, "but at the same time," he added, "I knew there was a little gas, and it could be detected by the smell." There was a certain amount of pressure, and the oil of this particular tank had fallen. He had never observed a leakage before, but there was always a smell.

At the inquiry Capt. Hocken was examined by Capt. J. H. Thomson, Chief Inspector of Explosives (with whom was Sir Boverton Redwood).

When you were pressing it up was there a strong order against smoking anywhere in the ship, including fore and aft? asked Captain Thomson.—Yes. The chief officer warned everybody not to smoke.

Is there any system adopted for periodically supervising the joints of the cargo hatches to see that they remain tight?—Yes, it is the chief officer's duty.

Supposing the chief officer found a leak in one of the joints, would he report to you?—Yes.

Have you ever found a leak, or has any leak ever been reported to you?—Not to my knowledge.

If you noticed a smell of benzine under the shade deck, would not that in your mind point to there being a leak somewhere?—I don't think so.

Where would the smell come from?—That is a question I have never been able to solve.

Were there any special duties devolving upon anybody in connection with the ventilation of the space under the shade deck?—It would be the duty of the chief officer to go occasionally and ascertain whether there was such an amount of vapour, judging from the smell, as to cause danger.

Can you tell us whether there were any of your crew who had not experience of this kind of cargo?—I cannot say. The officers had been in the ship since she was new, and they were mostly engineers.

Mr. Scrutton: Is it your experience that seamen and firemen cannot be kept from smoking except by somebody standing by them?—It is very hard, especially among firemen. I regard them as the scum of the earth.

Mr. R. L. Allinson, chief officer, thought the explosion was caused by a man lighting a match under the shade deck. He did not attribute the explosion to the gas coming out of the tank, but rather to an accumulation of gas underneath the bridge deck.

Mr. G. C. Pearson, second officer, saw no smoking on deck before the explosion, and there were no naked lights of any sort; but an A.B. said he had seen a man smoking on the forecastle head, and a clay pipe sticking out of a fireman's pocket. To strike a match under the shade deck would be equal to committing suicide. The cook had seen one of the firemen, a Turk, smoking a cigarette before this occasion, and the boatswain knocked it out of his mouth.

* When the crews sign on in Shell steamers there is a paragraph in their agreements prohibiting smoking and the employment of naked lights, except in places appointed by the masters. No matches or anything of an inflammable nature are allowed to be used in the Suez Canal.

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The news of these terrible calamities had just reached London when the report of the disaster to the *Sophie* (Actien Gesellschaft Atlantic, Bremen) as she was entering the Bosphorus came to hand, while the middle of the year had not been reached before the Shell steamer *Turbo* got into trouble. This steamer was off St. Margaret's Bay, near Dover, when she was struck by the White Star liner *Medic*, bound from the Thames to Liverpool, and "the heavy muffled sound of the impact as the two vessels came into collision brought the residents of St. Margaret's running from their houses."

The liner's bows were damaged, while the *Turbo* had a huge hole torn in the port side. One of her tanks was pierced, and tons of petroleum escaped on to the sea.

This chapter brings me back to the question of the alleged dangers of our storage and transport systems. Some of the greatest fires afloat and ashore, and even those which have taken place at refineries and storage installations, chiefly abroad (at Antwerp, Bombay, Calcutta, and other large centres of oil distribution), demonstrate that oil is never safer than when it is stored or carried in bulk; although, of course, no one would contend that petroleum spirit makes an absolutely safe cargo once the bulk is broken or a fire has broken out. Still, it is a fact, testified to by experts, that a perfectly-built steamer like the *Narragansett*, navigated under a system which reduces risk to a minimum, is in actual practice one of the safest vessels afloat, no matter in what climate or weather she may be steaming.

Properly-built and isolated storage installations such as we have on the Thames, the Mersey, the Ship Canal, and, indeed, on almost every water-way of importance in the world, are no longer considered sources of danger by experts. One of the latest conflagrations (Calcutta) proved that oil when properly stored in steel or iron tanks does not explode; if there is no water to boil and bubble it merely burns itself out, and does not run over or spread in any way.* Whatever danger there is arises from the storage of oil in the godowns of India, the open ambars of Russia and certain parts of America, and wooden and iron tanks erected in the early days of the industry.

The modern tank, properly protected and isolated, is a safe place of storage.

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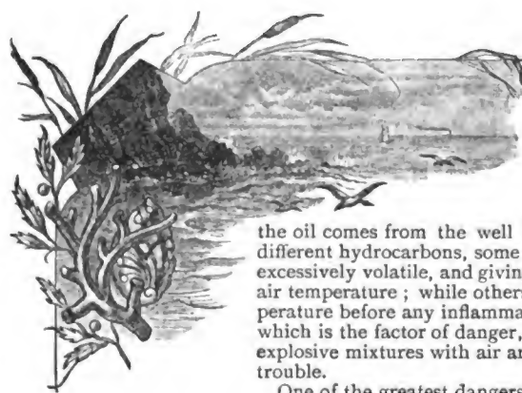
* At the time of the fire, there were in San Francisco 500 fuel tanks, containing from 10,000 to 30,000 gallons of oil each. Notwithstanding that for three days 118 of these tanks were surrounded by a mass of flames, not one exploded or took fire. The fire marshal, Mr. Charles Towne, in a letter to Dr. C. T. Deane, Secretary of the California Petroleum Miners' Association, dated June 1st, substantiates these facts.



ONE cause of fire is the formation of combustible vapours from easily volatile bodies, these vapours either finding their way through a leaky bulkhead to some source of fire, igniting and burning back to the source from which they sprang, or else forming an explosive mixture with the air in the hold. This has been the cause of most cases of fire in oil ships. When the oil comes from the well it consists of a mixture of a large number of different hydrocarbons, some of them, like petrol or petroleum spirit, being excessively volatile, and giving off inflammable vapour well below the ordinary air temperature; while others, again, have to be heated to a certain temperature before any inflammable vapour is developed. It is the flash point which is the factor of danger, as, if it be too low, vapours capable of yielding explosive mixtures with air are given off, and are liable to cause very serious trouble.

One of the greatest dangers with the vapour of volatile hydrocarbons is that the great weight of the vapour as compared with air will cause it to creep along surfaces for very long distances, and then on reaching a light the flame flashes back along the vapour to the source from which it sprang. It may be accepted that the transport and storage of refined lamp oils and residuum are practically free from danger, the only point to be guarded against being the ignition of the liquids in volume during fires, while the real dangers to be guarded against are to be found in the transport and storage of crude (containing highly volatile constituents) and petroleum spirit.

PROFESSOR VIVIAN LEWES.

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NO other branch of commerce has ever in so short a time attained such enormous proportions. Forty years ago the value of petroleum was unrecognised, and the vast sources from which it was to be derived, although separated from us only by a thin crust of rock and soil, were unsuspected. With careless feet we travelled over hidden treasures more valuable and wonderful than the gold mines of California. Now the extraction, refining and transportation of petroleum form a branch of industry involving the employment of vast amounts of capital and millions of busy hands. Ships rendered no longer necessary for chasing the whale, by the introduction of an oil cheaper and more available than whale oil, have been freighted with the rival oil, and sent with it to the markets of the world. All this has happened since 1859.

W. T. BRANNT, 1894.

(Author of an American Work on Petroleum.)

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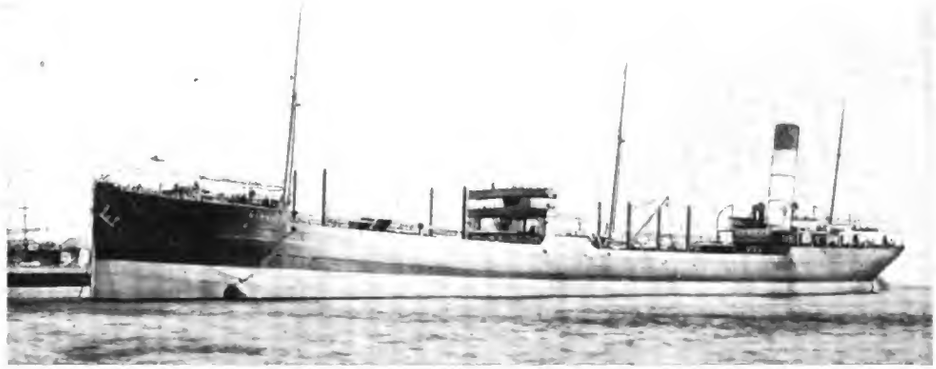
The *Caucasian* (managed by Messrs. Lane & Macandrew) is one of the largest steamers running to Black Sea ports for oil.



The *Pinna* (originally built for the Shell Company, but now managed by Messrs. Lane & Macandrew) is trading between California and Japan under a three years' charter.

The *Silverlip* (lost in the Bay of Biscay this year) was built on the same lines as the *Pinna*. She, however, carried a larger cargo, and was one of the two largest vessels built for the Shell Company.

[*To face p. 112.*

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CHAPTER XI.

Where Tank Steamers are Docked and Repaired. A great business on the Tyne.

"I know not where to seek, even in this busy country, a spot or district in which we perceive so extraordinary and multifarious a combination of the various great branches of mining, manufacturing, trading, and shipbuilding industry; and I greatly doubt whether the like could be shown, not only within the limits of the land, but upon the whole surface of the globe."

APPLIED to the two lines of remarkable shipbuilding and manufacturing towns which lie, linked together, along the banks of the Tyne between Newcastle and Shields (North and South), this is not the language of exaggeration. There is no river on which there are so many colossal industries standing in two practically unbroken lines. If we supply an obvious omission in the list, and introduce the great business of tank steamer docking and repair work, we complete a catalogue of trades and industries which promises for generations to come to stand as a record amongst the world's industrial and shipbuilding centres for the amount of money invested, the number of workmen employed, and the extent of the influence exerted by an enormous combination of capital and the highest type of skilled labour.

The Tyne is a river of remarkable records in every branch of the engineering and shipbuilding industries, and I am not in a work of this kind likely to overlook the fact that, the birthplace of many great ideas, it holds records for tank steamer building and repairing. I should say that no district or river could produce a list of revolutionary and world-wide inventions to match this :—

Locomotives—Stephenson.

Wire rope (without twisting the metal), and hence first Atlantic cable—Newall.

Rifled ordnance—Armstrong.

Hydraulic machinery—Armstrong.

Electric light—Swan (time and character of invention exactly with Edison).

The lifeboat—Wouldhave.

First screw collier—*John Bowes* (Palmer).

First iron bulk oil sailer—*Atlantic* (Rogerson, St. Peter's).

First tank steamer—*Vaderland* (Palmer), and more oil-carrying vessels and largest tonnage—Armstrong, Whitworth & Co., Palmers Shipbuilding and Iron Company, and others.

First in tank steamer repairing—Edwards and Smith.

In previous chapters I have dealt with the building of tank steamers at different shipyards on the Tyne; I am devoting this one to the triumphs of this river in the almost equally important business of ship-repairing. The home of tank steamer repairing work is at North Shields. This is an old town of great activity and enterprise; no part of the Tyne has a more interesting history, and it stands to-day more enterprising than ever, modernised and brought up-to-date by its huge fish quays and the shipbuilding and ship-repairing yard and docks of Smith's Dock Company, Limited.

The docks of the company are advantageously situated near the entrance, well within half a mile of the Tynemouth headland (one of the most interesting of the historic landmarks on the north-east coast), in the heart of the Harbour Boroughs, and close to the loading staithes of North and South Shields. They are the first graving docks one sees on entering the river, and these, with the pontoons and shipyards, extend from the Bull Ring to the Albert Edward Docks. The works at South Shields are opposite the westward position of the latter, and adjacent to Tyne Dock, which ships a larger quantity of coal than any dock in the world.

Every day the works are screened from the view of the passengers on the river (just as they were when I passed up on board the *Narragansett* two months ago) by a large fleet of vessels moored at the tiers, awaiting their turn to go into the docks or on to the

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pontoons of the company for repairs or general overhaul. The vessels which arrive at these docks are of all classes and sizes—sail and steam—and represent every mercantile and maritime nation in the world. The company docks and repairs nearly 1,000 vessels, of a gross register tonnage of over 2,000,000 per annum, or nearly 50 per cent. of the vessels which enter the Tyne for repairs, and of this number some ninety are tank steamers.

Although the present company was only formed in 1899, it is one of the oldest of the kind in the kingdom, having taken over the shipbuilding and ship-repairing undertakings formerly owned by Messrs. Thomas and William Smith and Messrs. H. S. Edwards & Sons, founded respectively in 1782 and 1768, and carried on continuously by various members of the families right down to the date of the formation of the present company. Even to-day, after a career of close upon a century and a half, the original families are still represented by Mr. James H. Edwards (the chairman) and Mr. George S. F. Edwards, both of whom were formerly partners in Messrs. H. S. Edwards & Sons and Messrs. Edwards Bros. Mr. Launcelot E. Smith (managing director) represents the other old firm, whilst the remaining members of the directorate are Mr. Henry Eeles and Mr. Arthur Scholefield, both well known in North of England shipping circles.

At South Shields, where there are three dry docks, 325 ft., 305 ft., and 430 ft. in length, what is known as the High Docks Department has a complete equipment of travelling cranes, machinery, and all the plant necessary for a business of this description. Across the road, at the head of the docks, are a very fine set of shops, built of steel and glass roofed, for the accommodation of the various trades employed in ship-repairing.

The directors have been fully alive to the fact that not only is up-to-date plant required, but that to secure the full benefit of its employment, as well as to get the best work out of their workmen, the shops must be well lighted and adequately ventilated. Improvements are constantly being effected at the High Docks Department, and these have for their object the economical and expeditious handling of every class of work undertaken by the company.

At North Shields there are three separate departments—the Pontoons Department, the Bull Ring Department, and the Shipyard Department. Each is under separate management, and fully equipped with all necessary plant and machinery. The company's long experience has convinced the heads that the system of dividing up the docks into small groups, each with its separate managers, staff, and machinery, is the most satisfactory, for it is only in this way that the work can be specialised and vessels undergoing repairs receive that constant and undivided attention which is so necessary in a business of such large dimensions.

The Pontoons Department comprises one dry dock of 300 ft. length and two floating pontoon docks, built on Messrs. Clark & Stanfield's well-known "off-shore" principle. The largest will take on a vessel up to about 460 ft., and is fitted with the most complete system of mechanical appliances for the rapid and economical handling of vessels. The pumping is done by eight large centrifugal pumps, each driven by a separate 60 h.-p. electric motor, and so rapid and efficient is their action that large vessels have frequently been docked and lifted clear of the water in twenty minutes. A powerful hydraulic crane and two hydraulic capstans are fitted on the top deck of the pontoon. The usual mechanical side-shores are supplemented by hydraulic side-shores to enable a vessel with a list to be docked and pushed upright, and to ensure the docking and lifting of vessels with the least labour and greatest despatch the sluice valves are controlled by hydraulic power from a central valve-house.

The Bull Ring Department, the one which has the greatest interest for oil men, consists of two docks, complete with all the necessary shops and machinery for dealing with overhauls and repairs of the most extensive nature to all classes of vessels, together with all the most improved appliances for rapidly and efficiently completing the overhauling and repairing of tank steamers. In this department the company have more especially laid themselves out for the repairing and overhauling of ocean-going, oil-carrying steamers, for which all the most modern appliances have been provided. Locomotive cranes circle the docks, and in the shops and sheds overhead cranes enable the workmen—all tried and trusted men—to carry on their work with comparative ease and the utmost despatch. Electric power and light are employed.

The docks in this department (numbered 4 and 5) occupy the full length of the present available space. No. 4 is 347 ft. long, 52 ft. broad, and 23½ ft. deep (now being enlarged), and No. 5 dock is 367 ft. long, 50 ft. broad, and 20 ft. deep, but, as has been shown, great as are the facilities of the company, more space is required and will shortly be provided.

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Owing to the handy size and depth of these docks, they are almost exclusively reserved for the docking and overhauling of tank steamers. This is a special branch of the ship-repairing trade to which the company have for many years devoted special attention, and for which they have provided exceptional facilities; it demands the utmost care, particularly now that benzine and petrol are being regularly carried by some of the largest steamers, and it is on record that the company have never had a serious accident to any of the hundreds of steamers of this description that have passed through their hands.

Many years ago when tank steamers were only coming into prominence, and men fought shy of working upon them, except at considerably advanced pay, the chairman of this company was one of the committee formed to deal with the subject, and he was one of those who maintained that, when proper care is exercised, fire and explosion risks are reduced to a minimum. That such care marks the control of Messrs. Smith's works is evidenced by that freedom from accident to which I have referred.

In the docks and those departments of the works which are allotted to the overhauling and repairing of tank steamers it is almost impossible to give an adequate idea of the great variety of work undertaken by the company. Tank steamer work is isolated as far as possible and specialised, the most reliable of skilled labour is employed, and every possible precaution is taken to ensure freedom from accident and the ultimate success of every job, whether of the nature of a refit, an overhaul, or an absolute conversion.

On the occasion of a recent visit to these docks I obtained a brief epitome of the particulars of some of the heaviest jobs undertaken by this company, and I give it here to show the varied and extensive character of this branch of the business.

When the *Tancarville* was converted into a floating oil depôt, the main engines and boilers were removed and the spaces sub-divided and converted into oil-tight cargo tanks. A new pump room and boiler house were built aft. In addition to a powerful pumping arrangement, a large liquid fuel burning donkey-boiler was supplied and fitted. In this way was the vessel adapted for the special trade to which I make a reference elsewhere.

A heavy repairing job was recently done on the *Helios*. The whole bow of this steamer was very badly damaged by collision. The frames, beams, deck and shell-plates were so bent and twisted into each other that it was found necessary to cut away the damage in pieces weighing several tons each. The club-foot stem was replaced by a new stem bar, which necessitated the altering of the fore foot and keel plates to suit.

When the *Elbrus* became the *Ottawa* she had new main and donkey-boilers supplied, and a new equipment of auxiliary machinery and cargo pumps. Her engines were thoroughly overhauled and renovated. The upper deck plating and part of main deck plating in range of oil tanks, the whole of the main deck forming bunker space casings, boiler room tank top, floors, frames, keelsons, and reverse frames were renewed, and the floors under the engines doubled. In addition, the whole of the oil tanks were tested throughout with hydraulic pressure.

The main engines and boilers of the *Weehawken* were lifted out, new main and donkey-boilers were fitted, and the main engines were erected and overhauled in the machine shop and refitted with a new condenser. She was supplied with new air and circulating feed and bilge pumps, shafting and propeller, auxiliary machinery and cargo pump. In addition, the whole of the boiler and engine room tank top with frames, floors, and intercostals were renewed, also frames and reverse frames and keelsons in the boiler room, besides which a considerable amount of work was done in the oil tanks, which were all thoroughly overhauled and afterwards tested by hydraulic pressure. A special arrangement for extinguishing fire and ventilating the tanks was fitted to adapt the vessel for carrying benzine and naphtha cargoes.

When the fine old Anglo-American tank steamer *Manhattan* was undergoing her No. 3 survey, the whole of the upper deck plating, the main deck forming the 'tween deck bunker, casings, boiler room tank top, floors, frames and keelsons were renewed. There were also considerable renewals to centre line and 'thwartship bulkheads. The fore deep and after peak tank tops were also renewed, and all the oil and water-tight compartments were tested under water pressure to satisfaction of owners and classification surveyors.

During May, 1897, the collier *Otterburn* was sold by Newcastle owners to a Russian firm and put into Smith's Dock Company's hands to be made suitable for carrying oil in bulk. She was an exceedingly light draught so as to get her through the canals from St. Petersburg to the Caspian. She was to be employed in carrying crude petroleum on the Caspian Sea, and Smith's fitted her up for this

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purpose by putting oil-tight bulkheads, trunk hatches, pipe installations, etc., into her. This is the only case I have come across of a collier being converted into an oil-tank steamer.

Some heavy work was recently done by the company on the *Tioga* (ex *Christine*). All the oil tank hatches were extended and fitted with necessary coamings and covers for the carrying of general cargo. The internal structural arrangements were considerably strengthened by the addition of web frames on each side of each compartment. Large buttress plates and extra horizontal stiffening were fitted to centre line and 'thwartship bulkheads, and the whole of the oil tanks were thoroughly overhauled and afterwards tested by hydraulic pressure. This vessel was ceiled out with bottom and spar ceiling for general cargo.

The *Gut Heil* was sent to North Shields when she was damaged by an explosion in a foreign port. The after bulkhead in No. 2 tank, together with shell, stringers, deck, etc., were extensively damaged, requiring a new bulkhead complete, with all the necessary stiffening angles and buttresses to be fitted. The greater part of the internal work in Nos. 1 and 3 tanks was renewed, and the remainder of the oil compartments were thoroughly overhauled and afterwards tested under hydraulic pressure.

When the *Tonawanda* (ex *Lucigen*) arrived at these docks, practically the whole of the deck erections were smashed, torn away and strewn about in a confused mass. The wrecked parts were all cleared away and renewed to original plans, and, in addition, a number of damaged shell and bulwark plates were cut off, faired and replaced or renewed. Owing to the exceptional weather experienced by the vessel, she was badly strained right fore and aft, and the whole of the rivetting had to be overhauled, one of the most perfect jobs of the kind ever done on this river, which is famous for its ship-repairing work.

Vessels have been fitted for heating and keeping creosote in a liquid state for pumping; the installation including heating coils, make-up evaporator, tanks for receiving water condensed in the coils, and special strainer for purifying and testing the condition of the water before being pumped back into the boilers or condenser. A number of tankers have also been fitted with a special arrangement for extinguishing fire and for ventilating tanks to adapt them for carrying benzine and naphtha cargoes, and several large tank steamers have been altered to enable them to carry general cargoes.

The continually increasing size of vessels coming to the Tyne for docking (and on the occasion of my visit to these docks I noticed that part of one of the dock-heads had been cut away to take in the tank steamer *Vedra*), convinced the directors some time ago that it would be necessary to lengthen the Bull Ring Docks, but the execution of the work presented a problem of no small importance. The acquisition of a large amount of house property and the diversion of a public street led to protracted and costly negotiations; fortunately, however, all difficulties have been cleared away, and a start has been made with the lengthening of No. 4 dock, which will, when completed, be capable of accommodating any tank steamer afloat and practically double the resources of the docks.

In spite of these extensions, however, the company find it impossible to keep pace with the demand for their specialities, and as it is impossible to further extend the shipyard, owing to its position between the pontoons and the Bull Ring, the directors have decided upon the bold course of removing the ship-building department to Middlesbrough, where a suitable site of some sixteen acres has been acquired. The site left vacant at North Shields will be used to extend the repairing department which deals with the tank steamer business. Repairing as well as building will also be undertaken at Middlesbrough, for it is intended to construct two graving docks of the largest size.

The company possess another department, hardly, if at all, of smaller importance to that of ship-repairing; I refer to the shipyard between the pontoon and the Bull Ring. This business was formerly carried on by Messrs. Edwards & Bros., who made a speciality of light draught cargo vessels, steam trawlers and drifters, steam tugs, ferry boats, and other small vessels of special type.

Smith's docks at North Shields are known to every one connected with oil-carrying shipping; indeed, I should say, they are known throughout the shipping world, and have a great reputation for specialist work in every branch of their extensive business.

Most of the ship-building companies which have made a speciality of tank steamer building also do a certain amount of dry docking and repairing work. In addition to these, several dry dock companies, including the Wallsend Slipway and Engineering Company and Messrs. Robert Stephenson & Co., Limited, Hebburn, have docks and staffs which are suitable for this class of work.

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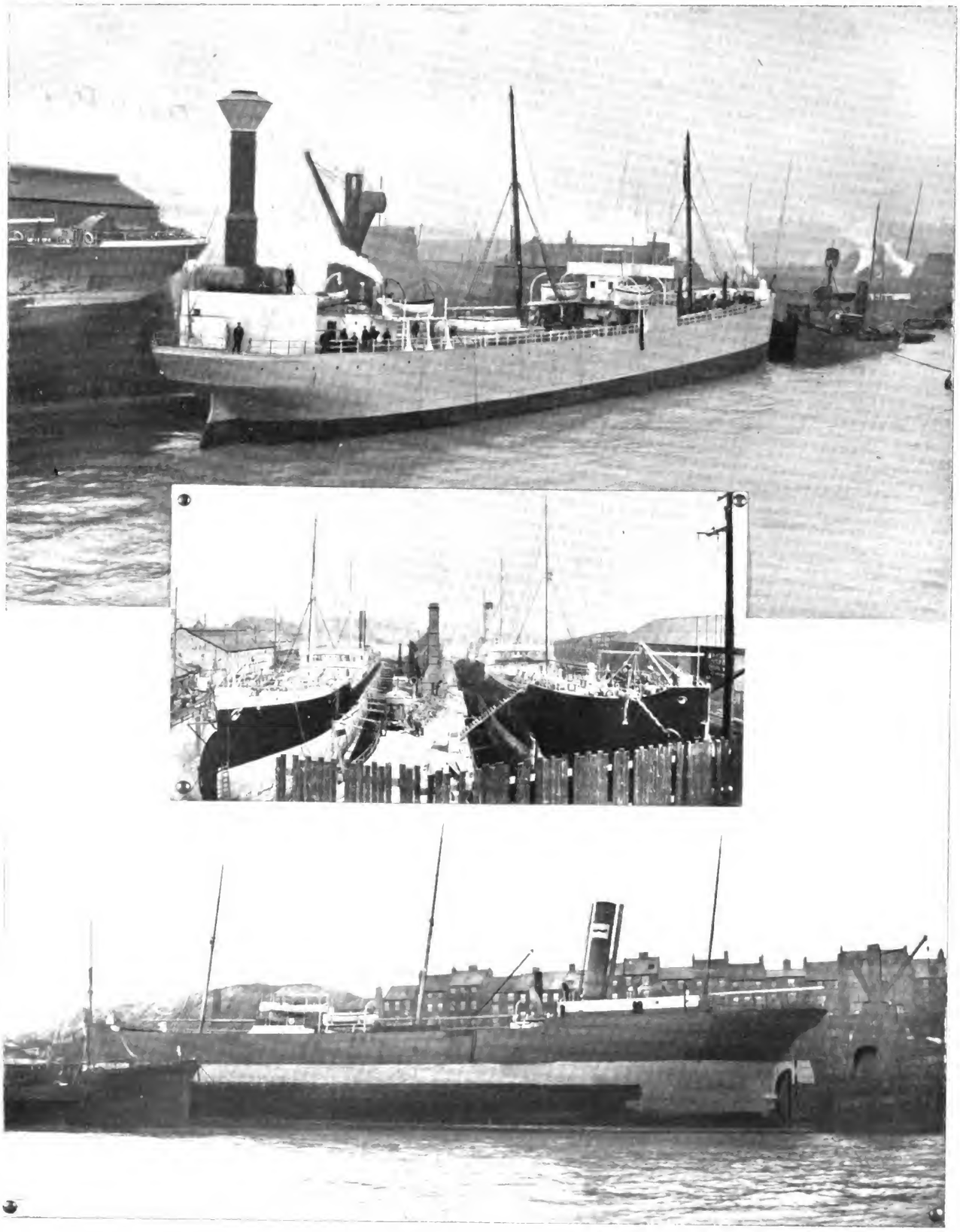

At the top, the *Tancarville* after being converted into a floating oil depôt.
In the centre, on the left, the Moss steamer *Lumen*, and on the right the *Oriflamme* (Messrs. Lane & Macandrew).
Below (on the floating dock) the *James Brand*, and on the left the equally well-known steamer *Chigwell*.

PHOTOS TAKEN AT SMITH'S DOCK ON THE TYNE.

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PART II.

SOME OIL PORTS

With a Special Chapter on

OIL PORTS IN THE MAKING

Being a Description of the Latest Oil Field Developments in British Colonies.

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AKINSKI DOCK AT BAKU, WHERE THE OIL-CARRYING VESSELS AND A NUMBER OF GENERAL TRADERS IN THE CASPIAN ARE REPAIRED AND OVERHAULED.

READ

OIL-CARRYING STEAMERS IN THE BAY AT BAKU.

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CHAPTER XII.

NEW York and Philadelphia for the old oil fields of Pennsylvania, Ohio and other States; San Francisco for California's unequalled and reliable producing territories; Port Arthur for the phenomenal oil-bearing tracts inland from the Gulf of Mexico; Constantza for the increasingly important shipments from the fields of Roumania; Balik-Papan for the mysterious and remote oil-yielding jungles of Borneo, and the Indian ports to which the petroleum of Burmah and Assam is transported, are all competitors of Batoum.

With perhaps one exception, Baku, Batoum is the most remarkable oil port in the world.

Thirty years ago, and ten years before the Baku-Batoum line made it possible for oil men to seriously grapple with the huge financial and mechanical problems of placing Baku petroleum on the European markets, Sir James Bryce, even in those days famous as a traveller and mountain climber, and now British Ambassador at Washington, arrived at Batoum on his way back from Armenia after his ascent of the sacred Ararat. It is just thirty years since Sir James Bryce entered the Armenian monastery of Etchmiadzin, near the foot of Ararat, and was presented to the archimandrite who ruled that illustrious house. The Armenian gentleman who acted as interpreter turned to the archimandrite and said: "This Englishman says he has ascended to the top of Massis" (Ararat). The venerable man smiled sweetly. "No," he replied, "that cannot be. No one has ever been there. It is impossible."

When Sir James Bryce arrived at Batoum it was in the hands of the Turks, "a small town with but little trade and only a few vessels lying off it." Concerning its future he wrote, ". . . . neither exports nor imports need be expected," and then, prophetically, "In the hands of the Turks it is useless, while, if the Russians acquire it, they will make it the terminus of the railway to Tiflis, and the outlet for all the Trans-Caucasian trade. Its transfer to them would, therefore, be really a gain to the world at large, as well as to the conquerors, and whatever results the present war may have, it is difficult, especially when one has just come from Poti, not to hope that such a transfer may be one of them."

The Russians who occupied Batoum on its cession to them by the Powers under the Treaty of Berlin would have difficulty in recognising in the present port, with its oil storages, case-making factories, transport systems and shipping, the miserable, malaria-stricken Turkish village visited by Sir James Bryce upwards of a quarter-of-a-century ago. Not that malaria is unknown in the town, but all agree that each year of improved sanitation makes it more habitable. Really fine buildings have been erected during the past few years; amongst these may be mentioned the Russian Orthodox Cathedral, the Georgian Catholic Church, and the imposing postal-telegraph office on the Mariensky. The esplanade is a fine sea-front. On this promenade, especially interesting to the Western, the representatives of many nations, Georgians, Russians, Armenians, Greeks, Turks, Kurds, Persians and many others, collect in considerable numbers and converse in their own language or in bad Russian.

During the twelve months of bloodshed, started in February, 1905, Batoum played a prominent part in the Caucasian revolt. When the massacres took place at the oil fields at the Caspian end of the Caucasus, business was brought to a standstill, oil-carrying vessels deserted the port, and fierce fighting took place in the streets. Amid the horrors of inter-tribal and civil warfare the petroleum business received a blow from which it cannot possibly recover for several years.

The town is flat and much of the immediate neighbourhood is marsh, from which emanates the malaria, which every year claims its many victims. There is reason for believing that the site of the town has been gradually piled up by the sea, for, geologically, it differs in a striking way from the surrounding country, where the spurs of the Caucasus begin almost

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immediately. The earthquake shocks, which have of late years menaced certain districts in the Caucasus, have been felt in Batoum, but, thanks to its distance from the seismic centre, no damage to life or property has been caused. One shudders when one thinks of an earthquake at Batoum. The sea, forced back by the upheaval of the ground, would return a wall of water. Batoum has, of course, its British colony. This small community organises football and cricket matches, takes a deep interest in the yacht club, and the British Consul, Mr. Patrick Stevens, is the pioneer and chief spirit of the volunteer fire brigade. In the British Consul the Empire has a valuable servant; knowing Russian like a native, and, what is even more important, understanding the Russian official, he would be hard to replace.

The port, a bay formation, is open on the north. On the west it is bounded by the Bouroun-Tabie promontory and a mole, and on the east by the estuary of the Bartzkhany River, while on the western part of the wharves, fronting the town for a distance of 4,781 ft., there are from west to east, the lighthouse, quarantine station, jetties of the Russian Steam Navigation Company, buildings of the Naval Department, Trans-Caucasian Railway goods sheds, landing stages of the Navigation Company, and the municipal and port authorities, a number of shipping offices, and a stretch of foreshore used by small coasting sailers.

In the eastern part of the bay is the oil harbour, which has a quay 2,695 ft. in length, and the oil mole, which, joining the eastern end in a right angle, curves westward and forms a harbour protected against north-easterly winds. From the east another mole extends almost parallel with the shore and joins the oil mole at its elbow. Between this breakwater and the shore is the harbour for coasting vessels. Here are the Rothschild works with four landing stages.

Of the structures the oldest are the oil and Bouroun-Tabie breakwaters. The first was commenced in 1885 and completed in 1888; the second, intended to prevent the harbour from silting up, was also started in 1885, but it was not finished until 1899. The western part of the harbour, started simultaneously with the breakwaters, was completed for a distance of 700 ft. in 1889, and the remaining part, which joined up with the breakwater, between 1890 and 1893.

According to the original project the oil harbour was to have a depth of 24 ft., but when the quay was finished there was water for vessels drawing 26 ft., and the authorities, by means of dredging, went down another 2 ft. in all parts in 1893. Resuming dredging operations in 1899, they were able before the end of 1902 to increase the depth of the harbour to 30 ft., and a recent inspection showed that there had been no change in the depth.

The breakwater for the protection of coasters was constructed between 1894 and 1897, and at the same time the depth of water at the quay was increased to 15 ft. There was an accumulation of silt in this harbour, and when vessels in the coastwise trade could no longer use it with safety, Rothschild secured it for transhipment purposes, and at the present time there is only a 12-ft. fairway to the jetties.

There is an insufficiency of berthing room in the harbour, and in busy times steamers have to wait their turns. Behind the oil breakwater the swell from the sea gives the officers of vessels a great deal of trouble, and in rough weather they have either to anchor their vessels in the roadstead or steam out to sea. Consul Stevens, in his report this year, says: "On occasions of this kind, when the harbour is full of shipping, the port presents a perfect pandemonium of infuriated choppy seas and underground swells, of ships rolling, pitching, plunging and ranging at their moorings, parting hawsers, wire ropes and cables, and colliding with other vessels, doing serious damage to themselves, other shipping and the harbour. Steamers, after breaking away from their moorings, have often been obliged to proceed to the roads or out to sea to weather a storm. Master mariners have repeatedly assured me that their vessels are, comparatively speaking, safer at sea in a gale of wind than they would be moored alongside the stone quays at the port of Batoum." In order to remedy this unsatisfactory state of things, schemes for the re-formation of the harbour have been submitted. The port authorities, who oppose these schemes, counting them unnecessary and costly, are working out more modest ideas for the improvement of the port. They state that, at the present time, when trade is leaving the port owing to the great political and industrial upheaval at Batoum, Baku, and the other centres of petroleum activity, the turnover does not in any way justify the spending of many millions of roubles on the absolute re-formation of the harbour.

Tank steamers are loaded near the petroleum breakwater, on to which all the pipe lines from the pumping stations are laid on to four racks. These racks are at different parts of the breakwater and enable four vessels to load simultaneously. Each rack is formed

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in a square excavation, out of which rises a number of curved loading pipes fitted with valves and attached to the hose through which the oil is pumped into the tanks of the steamers.

The most important group of Government tanks connected by pipe line with the petroleum loading berths are situated at Kobouletti, some twenty miles from Batoum. The reason given for this isolation is that in case of an attack on the port by a foreign power the tanks would be out of range of the guns.

The charges for loading, payable by the exporter, do not amount to more than thirty copecks per 1,000 poods of kerosene pumped.

All other loading and discharging work is carried on at the quay of the oil harbour and the Customs landing stages. Barrelled and case oil is handled at a separate quay in the oil harbour, where some six vessels can be loaded simultaneously, and it is in this harbour that timber vessels and the steamers of the volunteer fleet are berthed.

While tank steamers in a general way secure quick despatches, other traders often experience great difficulty in getting alongside owing to the shortage of quay accommodation, and cases are known where steamers have been kept waiting for a month.

The port records in a good year of business show that about 700 steamers and 2,040 sailers arrive from foreign ports, along with 723 steamers and 1,763 sailers engaged in the coastwise trade. Thus in a single year 5,226 vessels—and some of these were huge tank steamers and vessels of the volunteer fleet—have been known to make use of the port.

There are no port entry dues; the only real charge is for quay space. The authorities collect small amounts for anchorage and moorage privileges, and also for pilotage, which, however, is not compulsory. The poodage import of one copeck per pood on all goods loaded is collected by the Customs and goes entirely and direct to the Imperial exchequer. Up to 1901 a fifth of this impost went to the town. The Customs only levy an impost of forty copecks per 1,000 roubles worth of cargo loaded.

The subject of Batoum cannot be dismissed without a reference to the great Trans-Caucasian pipe line undertaking completed at the end of 1906. Baku and Batoum are joined by a pipe line which follows the ordinary railway track for a distance of 560 miles. This is the world's greatest and most costly oil pipe line. This line ought to have been completed many years ago. Extraordinary delays were occasioned by the Government insisting that the pipe line material and hydraulic machinery should be exclusively of Russian manufacture. It is characteristic of the native supineness of Russian enterprise and the *laissez faire* procedure of the higher bureaucratic departments that this most important project has been desultorily discussed by successive ministers for the last fifteen years. For a decade past, at least, it has been conspicuously obvious to the Caucasian authorities and the Imperial Government that the single track tank waggon system from Baku to Batoum was altogether inadequate and was every year cramping more seriously the export of petroleum to the Black Sea. At the Batoum end the oil business has always suffered under one of two evils, insufficiency of tank cars when the demand is great, and want of storage when the demand is weak.

The railway and newly completed pipe line will give an impetus to the foreign export of Russian petroleum, and oil men are hoping that, with the general resumption of work at Baku, there will be a full and intelligent employment of the improved facilities for the transportation of oil across the Caucasus.

In this connection it should be mentioned that the Government has been applied to on several occasions —the last time three years ago, when Mr. Wilson (an English engineer) and two Russian military engineers, Messrs. Oschtschurski and Sarakowski, were the applicants—for concessions to construct and work a ship canal between the Caspian Sea and the Black Sea. The making of such a canal—an engineering feat of unparalleled magnitude—could not be without an influence on the petroleum transport trade of the Caspian and Black Seas. Mr. Markowsky, chief engineer of the Baku Mining Department, mentions two canal projects—one through the north of the Apscheron Peninsula, and the other between the Sea of Azov and the north of the Caspian Sea, by way of the Manitch River. No concessions have been granted.

The following figures show the remarkably unsatisfactory changes which have taken place in the oil export business at Batoum :—

Year.	Poods.	(Tons.)
1899 ...	71,202,200 ...	(1,148,422)
1900 ...	65,377,000 ...	(1,054,477)
1901 ...	77,519,700 ...	(1,250,317)
1902 ...	84,234,000 ...	(1,358,613)
1903 ...	82,211,500 ...	(1,325,976)
1904 ...	79,526,900 ...	(1,282,692)
1905 ...	39,592,668 ...	(638,591)
1906 ...	30,710,909 ...	(495,337)

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IN addition to the export statistics on the previous page I give the figures for the first six months of this year (1907).

They are :— From Batoum.

Year.	Poods.	Tons.
1907	21,688,478	(349,814)
1906	15,346,462	(247,524)

The oil exports from the neighbouring port of Novorossisk during the past seven years were :—

Year.	Poods.	Tons.
1901	15,039,900	(242,579)
1902	10,453,000	(168,597)
1903	28,687,200	(426,697)
1904	27,060,300	(436,456)
1905	14,162,906	(228,434)
1906	7,214,383	(116,361)
1907*	3,558,682	(57,398)
1906*	3,483,815	(56,191)

* First six months.

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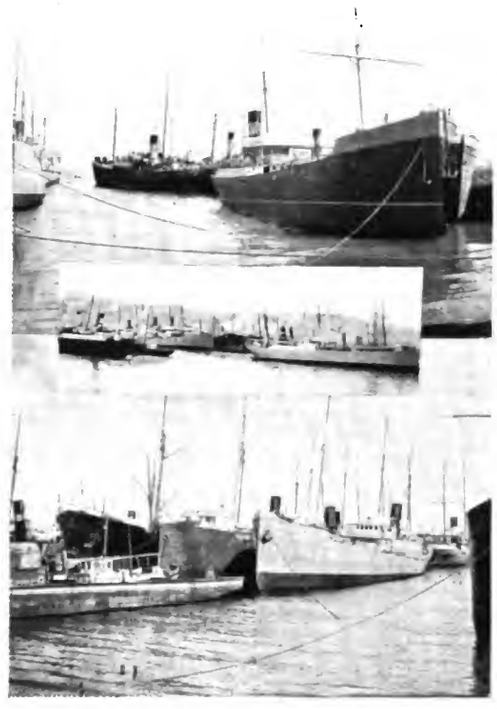
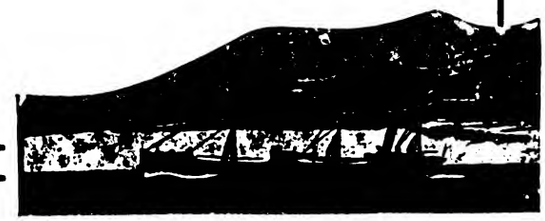
Types of Tank Steamers on the Caspian Sea.



THESE PHOTOS SHOW STEAMERS WAITING FOR OIL CARGOES IN THE BAY AT BAKU.



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CHAPTER XIII.

Baku: the Birth-place of the Oil-Carrying Sailer and Tank Steamer.

FROM the splendid tideless bay at Baku to Astrakhan, the great oil-distributing port at the mouth of the Volga, is practically 600 miles. These are the two most important oil-transporting centres in Russia. At Baku there is excellent wharf and dry dock accommodation, better piers than one expects to find for the many passenger steamers which run to the chief ports in the Caspian, and safe anchorage in the bay in all kinds of weather. When Volga navigation is in full swing Baku Bay presents a busy scene.

European passengers for Persia embark at Baku. Passenger and cargo vessels leave daily for Astrakhan and Petrovsk, for Krasnovodsk, on the Asiatic shore of the Caspian, and for Enseli, the chief Persian port. The imports from Persia chiefly consist of raw silk, carpets, rugs, raisins, and fruit, while the exports are oil, textiles, haberdashery, ironware, machinery, sugar, and canned goods. Tank steamers and hundreds of oil-carrying schooners and general traders of a distinctly Welsh type lie at anchor in the bay, from Bailov Point, where the navy of the Caspian has moorings, right along the city front, almost to the loading piers at the great refinery region at Black Town. It is from behind this same Bailov Point, where the oil field of Bibi-Eibat is situated, and where the most prolific petroleum fountains in the world have been brought in, that heavily-laden oil barges are brought by British-built tugs for their short run across the bay to the refineries. Away from the oil fields and the refineries the chief business of Baku is oil transport; it is this that keeps the shipping and the harbour employed—indeed, without it the shipping trade of the Caspian would be of very little consequence, certainly to Englishmen.

The history of the marine branch of Baku's staple industry is one of marvellous interest; connected with it are stories of thrilling interest, more romance than is generally associated with trade, and countless records of high-spirited enterprise and the display of an engineering and scientific knowledge quite unique amongst specialist work in the art of ship-repairing. The tank steamers of Baku were undeniably the pioneers of the world's carrying fleets of to-day.

One hundred and eighty-four years ago, when Peter the Great annexed Baku, and, according to a record in the archives of Tiflis, "gave special instructions for exporting oil up the Volga to Russia," there were oil-carrying sailers on the Caspian. In the reign of our own George II., when the merchants of this country were enthusiastically advocating the opening up of the trade route with England and the East, Jonas Hanway proceeded to the Caspian to investigate the failure of British trading concessions. In his bulky account of British trade over the Caspian Sea (1754) he mentions that the Persians used to load the oil collected on Holy Island (off Baku) into their wretched vessels; as the oil was in bulk and the vessels leaky, the sea was sometimes covered with it "for leagues together." There is, of course, no written history of these early oil-carrying sailers, but that they were the first to run in the oil trade in any part of the world there can be no doubt.

The earliest experiments with tank steamers were carried out on the Volga, where iron was expensive and the carrying of oil in bulk had to be done in wooden barges. In attempting to prevent the oil from escaping it was found that glue, when used in the barrels, was easily washed out by water, but it was soon noticed that the water itself would prevent the oil from escaping.

The next problem was to adopt some method of keeping the barge sunk in water at a certain depth. It was observed that as long as the oil in the boat was level with the water in the river it could not escape, and even if a crack developed it did not flow out, but the water flowed in and raised the level of the oil. It was impossible for large quantities of

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water to enter, there being very little space between the oil and the deck. Thus, under the least favourable conditions, these boats were considered a safe means of transport.

The last problem solved by a simple calculation was how to regulate the levels of the oil inside and the water outside. This turned on the specific gravity of the liquid pumped in, and when, after heavy residuals had been carried, the same barges were loaded with kerosene or crude petroleum, both liquids of lighter specific gravity, the escape of oil became serious, until the sharp-witted peasant owners of the barges conceived the idea of carrying a deck cargo of stones to make up the deficiency of weight due to the specific gravity of the oil being less. The same thing had happened in America, and prevented the earlier adoption of a more economical way of carrying crude petroleum, which, being of a very light specific gravity, escaped freely, and finally led the Americans to abandon the very idea which was satisfactorily worked out in practice in Russia a few years later.

The only reliable historians of the early days of the tank steamers on the Caspian were Mr. Gouli-chambaroff and Mr. Charles Marvin. From these authorities we learn that in 1878, when oil was carried in barrels, the Baku refineries produced 1,250,000 gallons of refined, but many years later (1885), when the bulk transport system was adopted, the output of the 120 concerns amounted to 120,000,000 gallons. Between 1879 (when there was only one tanker, owned by Ludwig Nobel) and 1885 (when there were one hundred) Russia invested £1,000,000 in the building of oil-carrying steamers. Steam navigation for the transport of oil grew and flourished amazingly in this land-locked sea, and the shipping records of those times show that frequently between twenty and thirty oil-carriers left Baku for the Volga in a single day.

It was in 1885, the great fountain year, that the oil fields were converting poor men into millionaires, and when one firm alone, Nobel Bros., found it possible to refine 1,500 tons of oil in a day. Nobel Bros. suggested to the directors of the Caucasus and Mercury Company that they should fit up a steamer with a cistern, so that the oil might be conveyed in an unbarrelled form to the Volga. In return for doing this they offered them a lucrative contract for carrying oil for a term of years. The Caucasus and Mercury Company, however, notorious for their want of enterprise, and making handsome profits by means of the State subsidy, had no incentive to act with enterprise, and the offer was refused. Thereupon the resourceful Nobel Bros. decided to run a fleet of oil-carriers themselves.

They owned engineering works on the Neva, where they could have steamers built, engines made, and all the pumping apparatus and appliances tested by skilled engineers. With the engineer of the family, Mr. Robert Nobel, on the spot, Mr. Ludwig Nobel controlling operations at St. Petersburg, and the talented scientific investigator, Mr. Alfred Nobel, to refer to in chemical matters, the firm possessed advantages which rendered serious rivalry from ill-educated and apathetic competitors practically impossible. In building the first steamer one or two difficulties were encountered. The Caspian is liable to sudden tempests, and it was necessary to take every precaution against the insecurity of such a lively cargo as oil. Wiseacres in Russia asserted that as the Americans had never deemed it feasible to bring oil to Europe in cistern steamers it was sheer folly for anyone to attempt it in the Caspian region. However, Mr. Ludwig Nobel was by birth an inventor, and he acted as a draughtsman for a steamer in which he arranged that the cargo should be kept under control by an elaborate and peculiar system of water-tight compartments, without in any way interfering with the rapid loading or discharging of the vessel. This experimental steamer proved a success, and paid for itself during the first navigation. Having got the lead, the Nobels kept it. They added to their fleet as fast as they could, and succeeded in getting some of the steamers cheaply constructed in Sweden. The profits were relatively enormous. With their steamers they beat the barrel transport so completely that the other firms had no chance against them, and as the profits were immediately applied to the extension of the business, the company in a few years became a gigantic one.

The first "liquid transport" or "cistern steamer" appeared on the Caspian in 1879, and twenty years ago Nobel Bros. owned twelve — the *Mahomed*, *Tatarin*, *Bramah*, *Spinoza*, *Darwin*, *Talmud*, *Koran*, *Calmuck*, *Zoroaster*, &c.

The dimensions of the *Spinoza* will give some idea of these earliest steamers. The vessel was built of steel, 245 ft. long, 27¾ ft. broad, and, when laden with kerosene, had a draught of 11 ft. The engines, 120 h.-p., sent her along at the rate of 10 knots an hour, at that time a good speed, and one that was not often done by British tramp steamers. She burned oil fuel, the bunkers containing a supply to last six days (sufficient for the journey from Baku

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to the mouth of the Volga and back). This steamer carried 750 tons of kerosene each trip. Some of the other vessels varied slightly from these dimensions; the *Koran* and *Talmud*, for instance, were each 252½ ft. long and 28½ ft. broad, and carried passengers as well as oil to Petrovsk and the Volga.

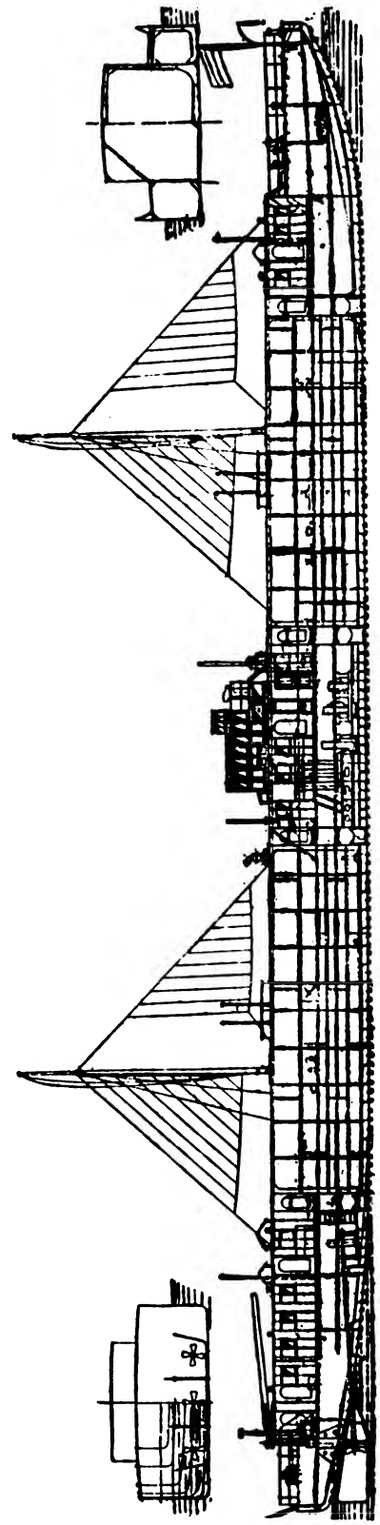
England was slow to recognise the potentialities of the marine branch of the Baku oil business, and twenty years ago we had built less than half-a-dozen tank steamers against something like one hundred launched by foreigners to run on the Caspian Sea and the Volga.

Owing to the splendid canal system connecting the Neva with the Volga, comparatively little trouble was experienced in conveying the Swedish steamers to the Caspian. In the case of the larger ones, they were despatched in sections, generally in two parts, to facilitate the progress through the locks. The open extremities were filled with iron bulkheads and the vessels put together again at Astrakhan—a plan which was adopted when steamers were sent from the Tyne in the early days. Early on, Nobel Bros. opened a yard at Astrakhan to repair their Caspian oil vessels and the flotilla of smaller steamers on the Volga. Directly their cistern steamers proved a success other firms hastened to purchase similar ones for the Caspian, most of them being from 150 to 250 ft. in length. Some of these were built by Messrs. Armstrong, Mitchell & Co. on the Tyne. As many as twenty new tank steamers arrived at Baku in a single season.

The creation of such a fleet is an exploit of which any engineer might be proud, and Mr. Ludwig Nobel may certainly claim credit for having, by the substitution of the steam-propelled 200,000-gallon floating oil-tank for the 40-gallon wooden barrel, effected a great revolution in the Caspian petroleum industry.

The growth of Caspian shipping has been particularly marked during the past ten years.

The Baku Excise Department reported that the total number of steam and sailing vessels built up to September 13th, 1899, was 345, with a total capacity of 8,644,884 cubic ft. Of these, 133, having a capacity of 4,821,679 cubic ft., were tank steamers; and 212, with a total capacity of 3,823,205 cubic ft., were sailers, so that the proportions of the total of the two descriptions were 55·8 and 38·5 per cent. respectively. In 1899 it was estimated that eighty-eight in number, or 66 per cent., of the tank steamers on the Caspian were constructed in foreign countries, 49 per cent. being built in Sweden and the remainder in England, but in later years England took the lead.



The *Vandal* is one of Nobel Brothers' tank barges employed in the transport of oil from Rybinsk to St. Petersburg, by way of the Volga and canal systems. She is driven by three Diesel motors of 120 H.P. each, is 244 ft. long, 31½ ft. wide, and 8 ft. deep, and was constructed at the Sormovo Works, Nizhni-Novgorod. Her success led the owners to build the *Sarmat* and other barges on the same lines.

Shallow draft steamers with oil engines are being gradually introduced into the oil-carrying trade of the Volga and its tributaries; they draw less water than vessels with the ordinary steamer engines, and in a few years there will be quite a large fleet of them on the Russian rivers and the Danube.

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The Baku shipowners also sent orders to Bremen and Stettin, where they built the vessels at a cheaper rate, and though they were not of such high finish as those built in England, they were strong, and, said an authority at that time, "they served the purposes of the Caspian trade." One reason why early steamers built on the Volga were more suitable for the trade was that those from foreign countries could not be made wider than 32 ft., as the Marinsky Canal, through which they had to pass, would not admit vessels of greater width. The *Tatiana*, built in England, had a carrying capacity of 210,000 poods and a length of 286 ft., which made her nine-and-a-half times longer than she was wide.

According to the latest statistics, there are 265 steamers and 549 sailers on the Caspian Sea. The aggregate tonnage of the steamers alone is 164,290 tons, and the original cost runs to about £4,200,000. Most of the vessels were built at Russian shipyards. This is explained by the fact that Russian shipyards are protected against foreign competition by high import duties. They also have geographical advantages over foreign shipyards, which can only deliver steamers to the Caspian in sections and with considerable difficulty. The isolated position of the Caspian has unfavourably influenced the quality of the fleets, and is accountable for many of the defects noticed by experts who have inspected them.

The officials of the Board of Navigation recently published a report which was remarkable for its outspoken criticism of the defects of the home-built vessels. The shipyards engaged in the construction of vessels for the Caspian do not turn out work that is up to the mark. It is only in rare instances that a vessel, when she strikes anything or gets into really bad weather, does not suffer damage to her hull; the general experience is that her rivets become loose and that the iron plates crack and bend. Damage to propellers is most frequent, especially during the autumn gales. The vibration causes breakage of shafts and screws, which, on investigation by the Technical Board of Inspection, are generally found to be made of unsatisfactory materials. According to some shipbuilding experts, damage sustained by propellers is frequently due to other causes. They say the materials of which the shafts are made is of the best quality, but the work of casting and finishing is imperfect, and at some works, at which profit is the chief consideration, and where improvements in shipbuilding are at a discount, a great deal of imperfect work is turned out.

Russian shipyards turn their vessels out carelessly, and do not appear to trouble so long as they can deliver within the contract time. The result is that vessels with loose-working machinery are frequently met with. Directly a vessel starts work the engines develop defects, work loosely, and get out of gear. Very frequently one reads officially-confirmed reports of damage sustained by new vessels even before they have been delivered to the owners. Some develop defects on their first run to Baku.

The vessels built at foreign shipyards for the Caspian fleet are also declared by these Russian reports to be very defective, although it is known that amongst the largest and most modern of the tank steamers running out of the bay at Baku are several British-built specimens of marine architecture about which authorities cannot speak too highly. Generally the Caspian shipowners take over vessels built in foreign shipyards "for the market"; these, the experts say, are built of plates which have been rejected by the superintendents responsible for the building of ocean liners for first-class firms. The same thing applies to the engines and the general outfit of the vessels. It is these "jerry-built" steamers which find their way to the Caspian Sea, the builders being under the impression that in the Caspian Sea vessels of this description will meet the needs of the trade just as well as those which have been properly built, because the builders are under the mistaken impression that the Caspian Sea is little better than a lake.

Russian shipmasters of experience—men who have been in command of vessels trading in all parts of the world, and some of them speaking the English tongue—told the author that some of the autumn storms met with on the Caspian equal in severity anything encountered between New York and the Irish coast. The swell on the Caspian after a long blow is aggravated and heightened by an extraordinary rebound action of the waves, caused by their breaking on the shore and also by the wind sweeping across the steppes and striking the Caucasian chain.

There are openings for British shipbuilders to do business on the Caspian Sea. Some first-class vessels—the well-known tanker *Paddy* and others I have inspected—have been sent out by British builders, and there is no reason why others should not follow when the Baku industry has passed through the present crisis, and efforts are being made to restore the petroleum business along the banks of the Volga and in the interior of Russia.

During the phenomenally prosperous period of

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1897-1901, the Anglo-Russian companies owned oil-carrying vessels on the Caspian. When the Russian Petroleum and Liquid Fuel Company took over the Tagieff property (the famous XIX. group) in 1897, the tank steamers *Bibi-Eibat* and *Lindberg*, worth £27,000 each, were included in the transaction and assisted to pay those satisfactory dividends which drew so many thousands of investors into the earliest of the Anglo-Russian concerns. They were built in Sweden, had engines of 1,000 i.h.p., and carried 60,000 poods of astatki of a specific gravity of ·910. So well were they equipped with pumping machinery that Mr. Tagieff, their Tartar owner, guaranteed them to load in four hours and discharge in three.

The London company also took over the Swedish-built steam tug *Naptalar*, which was capable of discharging barges at the rate of 12,000 poods an hour; a number of tank barges for the Baku-Astrakhan trade; and a schooner used for conveying crude from Bibi-Eibat across Baku Bay to the refineries at Black Town.

The Baku-Russian Petroleum Company, a year later, secured the British-built tank steamer *Raphael* from Mr. Arafellov; Mr. Suart sent the *Venture* (built by the Caledonian Shipbuilding and Engineering Company, Ltd., Dundee), the *Paddy** (Messrs. W. Dobson & Co., Newcastle), and other oil-carrying vessels from this country down the Volga to the Caspian; and the Schibaieff Petroleum Company secured control of several vessels, including the successful tank steamer *Slava*. British capital was also interested in the barge oil transport trade on the Volga. Most of these vessels have passed under the control of Rothschild, and at the present time the Anglo-Russian concerns have practically no financial interest in the huge business of Caspian and Volga transport.

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* This Tyne-built and Irish-named steamer still trades between Baku and Astrakhan. She is one of the largest steamers on the Caspian, and, managed by Mr. A. G. Parker, she has proved herself one of the safest and most successful vessels in the trade. It was on board the *Paddy* that members of the British colony sought safety during the massacres two years ago.

SOME 1,500 wooden barges of a capacity of close on 200,000,000 poods are engaged in the oil-carrying trade on the Volga. The majority of those built in recent years are of iron and steel, and carry huge oil cargoes, some of the largest as much as 8,000 tons.

I have just been informed by the well known Volga Trader, Mr. D. V. Sirotkin, of Nizhni-Novgorod, that he has had the oil-carrying barge *Martha Posidnetza* built at the works of Mr. Schorina, of Torochowitz, on the Rlizina, a tributary of the Oka. She is no less than 504 ft. in length, 70 ft. in breadth and 12 ft. 4 in. in depth, and is one of the greatest barges in the world. She has been designed to carry a cargo of 560,000 poods (about 9,000 tons) of oil, and will be steered by four rudders.

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PETROLEUM was gathered upon the Watson Flats near Titusville (the location of the Drake well) and McClintockville, just above Oil City, as early as 1840. Round or square holes, hand dugs of various depths, were carried down sometimes more than 200 ft., air being supplied to workers by a bellows. Oil was taken out with buckets by hand or a windlass. This method has been adopted for centuries in Roumania, Russia, India, Japan and other countries. Salt wells which frequently produced oil or gas were drilled in China many years before the process of drilling or boring was known in any other country. The lever on which the Chinamen "danced" was the forerunner of the walking beam which is now universally used, and the principle employed in the method of drilling wells in China was the same as that which is practised at the present time.

JOHN EATON, in "Oil Region Reminiscences," 1907.

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CHAPTER XIV.

The Rise and Present-Day Position of Port Arthur, Texas, with a Description of the Port's largest Tank Steamer.

THERE are two oil ports to which, for various reasons, I cannot hope to do adequate justice here; one of these is the smallness of the space which I now find at my disposal. The ports are New York and Philadelphia. The history of these huge ports, so prominently associated with the great and fascinating subject of the pipe lines and refineries of America and the development of the American export of oil, will provide material for use at a time when it will be possible and convenient for me to do justice to the many facts which I have succeeded in collecting.

I hope to have a better opportunity than the one I am now allowing to go by of writing the story of the rise of these two ports, and explaining some of the numerous ways in which they have advantageously influenced the oil export trade in practically every part of the world.

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There are several ways in which Texas differs from the other great oil fields of the world. It has no secret history, and I attribute this to the fact that those who have built up the industry have favoured publicity from the start. The word "secrecy" has no meaning to the oil men of Texas, and this is not due to that colossal conceit which was an amazing characteristic of its pioneer oil men, but rather to the multiplicity of interests concerned and the honourable and enterprising character of local petroleum journalism. I can never attempt to appreciate the potentialities of the petroleum industry, the possibilities of an adequate augmentation of production to meet the steadily increasing demands of consumption, without recalling my own personal experience of developments in Texas, and remembering that what Texas has accomplished during the past five years is the strongest possible evidence anyone can advance in support of the idea that the day is not far distant when the producing branch of this industry will be undeniably universal.

Texas oil history appeals to the imagination. Texas as it was eight years ago, with only the Corsicana field to entitle it to a position on the oil map, was a producing State of scarcely any consequence; Texas as it is can claim to be a great figure and factor in the industry, the rival of California in a keen competition for the position of premier producing State in America; Texas as it will be, allied with Indian Territory, is to many of us one of the most fascinating problems in the commerce and industry of petroleum.

Texas is twice as large as Great Britain or Italy, and larger than France or Germany. On its plains, stretching between Humble and Beaumont and the Gulf of Mexico, one oil town after another has been created, until we are led to recall the lines of Edward Wilbur Mason—

"I am the plain: barren since time began,
Yet do I dream of motherhood, when man
One day at least shall look upon my charms,
And give me towns like children for my arms."

Oil has given Texas one town after another—Beaumont, Sour Lake, Saratoga, Batson and Humble: to these it has added oil ports, and one of the most amazing developments has been the running of the pipe lines of other States through its heart to the Gulf of Mexico.

I cannot remember that the writing of any part of this book has given me more pleasure than the brief description of the remarkable rise of Port Arthur, which, if not such a great oil port as Philadelphia, New York or Batoum, is, at any rate, one of the most progressive in the world, and one which is sending large quantities of oil to this country and other parts of Europe.

Texas is the most striking example I can recall of the influence of oil in the maritime affairs of the world.

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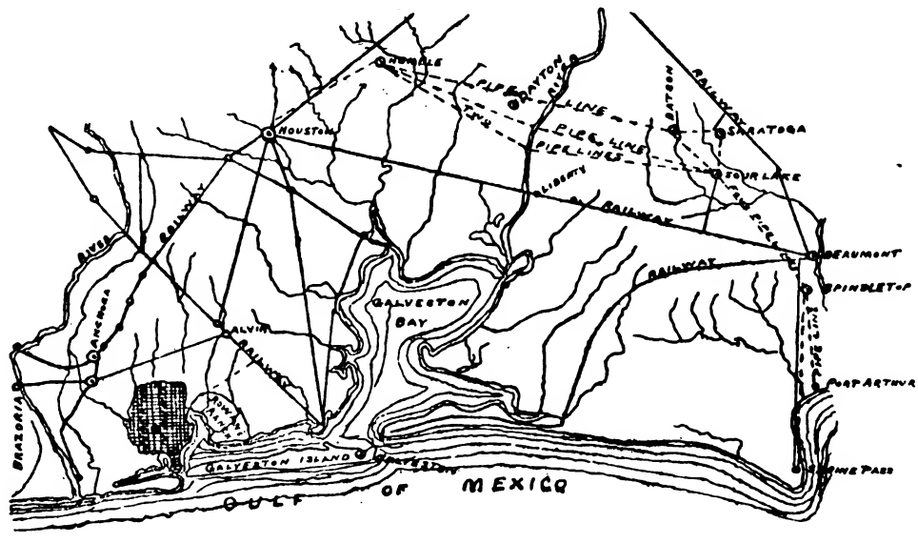
Galveston, the premier port of the Gulf of Mexico, west of New Orleans, notwithstanding the great gale of 1900, still retains its supremacy. The fear of a recurrence has, however, brought other harbours to the front. Port Arthur is one of these. It is peculiarly a commercial city—a place where ocean and railway meet. Time was when neither rail nor ocean were there, and if they had not been joined Port Arthur would not be on the map.

When Mr. A. E. Stillwell completed a railway from Kansas City to tide-water, a distance of 800 miles, and christened the terminal Port Arthur, something like ten years ago, the location appealed to business interests, and now a clean, prosperous town is steadily growing and accumulating a coastwise and ocean tonnage.

other canal or artificial channel in the United States, being 25 ft. deep, with a turning basis 500 ft. across, so that the largest vessels may be loaded at the wharves, a few of the largest boats being loaded to 24 ft. and the remainder of the cargo lightered over the bar. The Government is now excavating a 9 ft. channel from the mouths of the Sabine and Neches rivers to Port Arthur to permit barges loading there and reaching open water. Latest available figures will give some idea of the importance of the port. In 1900 twenty-one vessels, with a registered tonnage of 36,734 and a valuation of £567,067, cleared from Port Arthur. In 1904 387 vessels, tonnage 647,555, valuation £3,063,547, cleared. In 1905 and 1906 there has been a steady increase, until it is now claimed that the Port



The Sabine and Neches rivers form Sabine Pass, 100 miles north-east—more north than east—of Galveston, and Sabine Lake, six or seven miles wide and ten or fifteen miles long, separates the south-western point of Louisiana and the south-eastern point of Texas.

Port Arthur is situated twelve miles south-west of Sabine Pass, near where the lake stretches away into the Gulf of Mexico. The harbour is landlocked. Several things happened to help Port Arthur to make fame and business. Oil was discovered, rice farming inaugurated, and great lumber interests consolidated. Galveston was not only too far away, but its exposure to recurring storms was a menace to investment, so Port Arthur was taken in hand by business interests and the Government.

A channel seven miles long was excavated from the open deep water of the Gulf to Port Arthur. This channel has a greater uniform depth than any

Arthur loading list almost equals that of Galveston. Of the vessels registered at Port Arthur (46 in number) 14 are tugs used in towing oil barges and nine are tank steamers.

The discovery of oil in Texas and Louisiana made Port Arthur an ideal location for refineries, the products of which have found convenient and cheap transportation to Eastern and European markets.

The Gulf Refining Company, Texas Company, and Security Oil Company have extensive refineries at Port Arthur and Beaumont, only twenty miles distant, and their business and profits have been considerably increased by reason of ocean transportation. The Guffey, Texas, Standard, Shell and other companies have steamers running regularly in the oil trade of the port. The Standard sends Texas oil up to Philadelphia and New York, and from there across the Atlantic to this country and the Continent.

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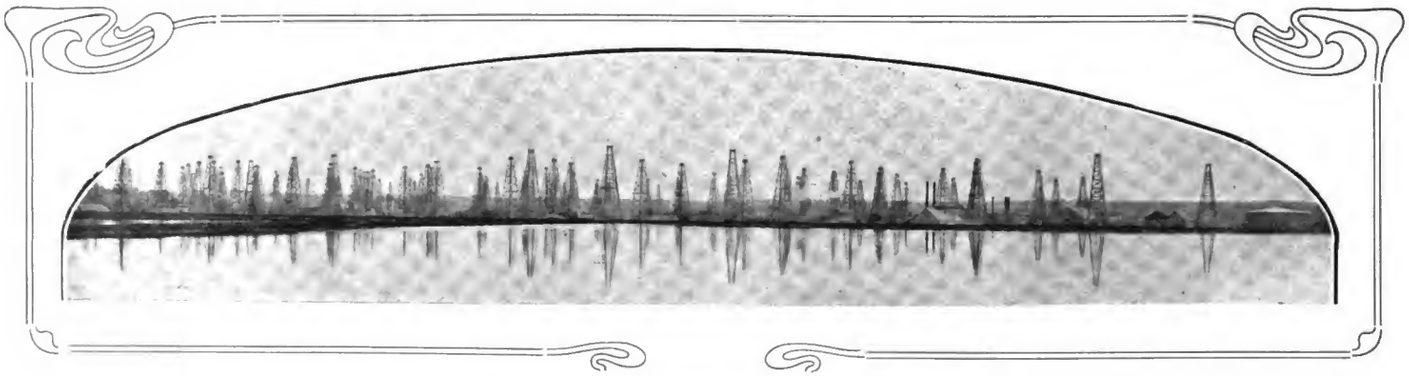

OIL CARRYING VESSELS AT PORT ARTHUR, TEXAS.

THE GULF COMPANY'S STEAMER
LIGONIER.

THE SHELL STEAMER
PECTAN.

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Most of the Shell shipments, under agreement with the Guffey Company, are to this country. The Shell was one of the first companies to recognise that Port Arthur had a great future as a shipping port; it was started by the Beaumont oil discoveries, developed by the Guffey (now the Gulf) refinery undertakings, and established by a multiplicity of great trading and financial interests which aim at bringing Mid-continent oil by pipe line to the port.

When I was in Texas in 1902 the Guffey refinery was just starting to work an organisation which was easily ahead of anything then in existence in these parts. Its progress, now that it is worked by the Gulf Refining Company, is one of the most remarkable facts in the history of Texas oil. Thousands of companies were formed in the days of the boom; how very few of them became established concerns is well known; but what is now known all over the world as the Gulf Company has prospered—not only in the refining branch, but in every branch of the industry: producing, refining and transport. It is the largest shipper of Texas crude oil and its products, and the refinery at Port Arthur is the largest independent oil refinery in the country.

The company is interested in most of the chief fields of America; it has shipping facilities at all of the chief oil ports and branch offices in every importing country, not the least important of these latter being at Paris, where Mr. H. E. Watson has his quarters as the European representative.

The company has just contracted with the New York Shipbuilding Company for the construction of the largest tank steamer ever built in the United States.* The Gulf Pipe Line Company, which has the most complete pipe line systems in Texas, is constructing five hundred miles of 8-in. pipe line, which will connect the Indian Territory oil fields with the Port Arthur refinery, and the increased business which will follow the completion of this line necessitates the addition of this steamer to the present considerable fleet, already the second largest in the business. This will be the ninth oil-carrying vessel built by the New York Shipbuilding Company, more than has been turned out by any other American shipyard. (I refer to some of their steamers elsewhere.) The principal dimensions of the new steamer, designed by Messrs. Matteson & Drake, of Philadelphia, are as follows:—Length all over, 441 ft.; length between perpendiculars, 425 ft.; beam, moulded, 55 ft.; depth, moulded to spar deck, 30 ft.; mean draught, 23 ft. 6 in.

The cargo capacity is 2,520,000 gallons, and besides this the dead weight on the above draught includes fuel oil, feed water, drinking water, stores and water in cofferdams. In size this steamer ranks among the largest in the oil-carrying trade of the world, and is about 1,800 tons larger than the next largest American-built oil steamer.

The engines are aft. She is of the spar deck type, with open forecastle, bridge, and a raised quarter-deck aft. Two decks run fore and aft, except in way of engine space. Oil is carried in sixteen tanks, formed by nine transverse bulkheads, and a centre line longitudinal bulkhead. Aft of these is the pump room, which occupies the centre of the ship on an oil-tight flat 12 ft. above the keel. On either side and below this room are the two fuel oil tanks.

An expansion trunk, 10 ft. wide, extending between the main and spar decks, is fitted each side of the central line bulkhead and for the full length of the cargo and fuel oil spaces. The sides are extended down to the flat in the fuel oil space and enclose the pump room.

The main deck spaces abreast the expansion trunk are divided into four compartments. The forward compartment on each side is for package freight, and the other six are summer oil tanks—to be used when a cargo of light oil is carried, or in summer when a less freeboard is allowed. Each of the main oil holds and wing compartments—twenty-four in all—is fitted with a hatch 6 ft. 6 in. by 6 ft., having a steel oil-tight cover.

Aft of the fuel oil tanks and pump room and separated by a cofferdam, which extends the full width and depth of the ship, is the machinery space. Coal bunkers are provided abreast the boiler-room, and are filled through a hatch 20 ft. by 4 ft. in the raised quarter or poop deck, and a hatch and saddle back 20 ft. by 8 ft. 8 in. in the main deck. In the engine room a gallery deck has been built, on which is located much of the auxiliary machinery.

A double bottom is fitted under the boiler room for carrying feedwater, and under the forward part of the engine room for water ballast. Between the oil holds and the fore peak tank, ordinary freight is carried in the hold and 'tween-decks, fitted as usual with battens and ceiling. Access is made by means of hatches 19 ft. 6 in. by 16 ft. in each deck. The peak tanks extend to the main deck; over the forward peak is a store-room, in the after end of which is the steel chain locker.

* The *Oklahoma.*

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The bridge erection is enclosed by steel bulkheads at each end. A large store-room is located in the centre, extending the full length.

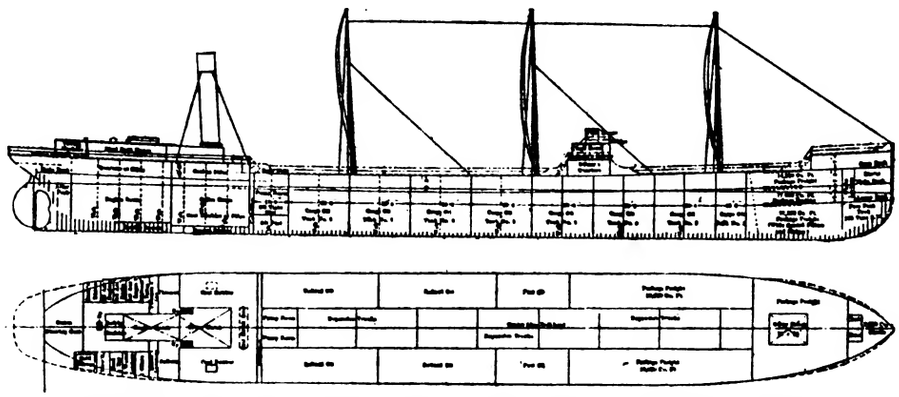
The scantlings and general construction of the steel hull are as required by the rules of the Bureau Veritas. The forward part of the vessel is specially strengthened to enable her to proceed safely through the thick ice that so frequently blocks the northern rivers and harbours in winter. Simplicity of construction and as few parts as possible have been the aim of the designers. Light and well-ventilated quarters are provided for the officers and crew. This is a matter that cannot be overlooked in designing an oil steamer.

Side lights are all of brass; those through the hull sides are 12 in. in diameter in the clear, and are fitted with deadlights; those in the steel houses are 16 in. in diameter, but without deadlights. Deck lights are fitted in poop deck over all rooms below. All lights and outside doors are provided with brass wire screens, and as a further aid to ventilation the lights are provided with air scoops.

As a large proportion of the stores for the round trip are taken on at Philadelphia or New York, the refrigerating plant is necessarily large. There are three cold storage rooms—two on the main deck and one in the poop deck house. Each of these is insulated by mineral wool, enclosed air spaces, and the usual wooden wall. A 2-ton "Allen" dense air ice machine is installed on the gallery deck in the engine room; and besides being connected with the insulated chambers is connected with ice pans of sufficient capacity to make two hundred pounds of ice a day.

The miscellaneous fittings of the steamer embrace everything that can facilitate safe and efficient handling of the ship or cargo. Access to all parts is by means of metal ladders, those in the oil holds being made of ordinary angle bar stringers and bar rungs.

The deck outfit, which conforms to the requirements of the United States Steamboat Inspection Laws, includes the necessary number of fire buckets, extinguishers, axes, life preservers, and lifebuoys. There are three 20-ft. metallic life-boats, and a 20-ft. wooden launch propelled by a 6 h.-p. gasoline engine.



The above are inboard profile and deck plans of the bulk oil-carrying steamer which the New York Shipbuilding Company are building for the Gulf Refining Company. Description in text.

The steamers of this company have been specially built to carry oil between the Gulf of Mexico and Bayonne and other ports on the north-east coast. It is known that further additions to the fleet will be necessary shortly as the company are increasing the deliveries of crude and the output of the huge refineries at Port Arthur.

Hand deck pumps, in number and size as required are provided. Two very important means of communication are the De Forest Wireless Telegraph outfit and the submarine signal system, as manufactured by the Submarine Signal Company, of Boston.

The fire system consists of a 3-in. main with connections about 75 ft. apart for 2½ in. hose. At each plug is located a rack, with 50 ft. of hose. Water from the sea is supplied by the following pumps: forward bilge pump, donkey pump (12 in. by 6½ in. by 12 in.), and the auxiliary feed pump. The donkey pump has suction from all compartments in the after end of the ship, as well as the sea, and thus handles all water ballast. An independent bilge and ballast system is provided forward.

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A steering station is located on the aft house, as well as in the pilot house. From each of these places a telemotor connects with the steering engines located in the after end of the poop. There are two vertical engines arranged so that either may be readily thrown into gear. The rudder stock extends above the poop deck, and is provided with a spare tiller, to be used in case both steam engines are disabled.

The deck machinery includes four mooring engines with double cylinders, 8 in. by 8 in., and fitted with drums for handling 1½ in. wire rope; one deck winch with double cylinders, 8 in. by 8 in., provided with hoisting drum and two gypsies; a capstan on the poop deck, driven by an 8 in. by 8 in. double cylinder engine on the main deck; and a windlass for a 2⅛ in. chain. The windlass engine, located on the spar deck, is of the double reversible, vertical type, with cylinder 12 in. by 12 in.; this engine drives, through vertical worm shafts and bevel gearing, the windlass and drums of sufficient size and strength for handling 1¼ in. wire rope mooring lines. One gypsy lead is connected with each drum.

A towing machine of extra heavy construction is on the poop deck aft of the house, and protected by a continuation of the house top aft. The two cylinders are 18 in. by 20 in., and are provided with reversing valve and automatic gear, capable of paying out eight fathoms of the hawser while opening the valve to its full extent. The drum of the machine is capable of stowing 3,200 ft. of 2¼ in. wire hawser. An efficient foundation is provided between the poop and the main deck.

The cargo oil system is of the latest type, including every means available for the quick and safe handling of the cargo. The four pumps are of the Snow Steam Pump Company's duplex type, two being 16 in. by 14 in. by 12 in., and two 8 in. by 6 in. by 12 in. There is a 12 in. main suction line on each side of the centre line bulkhead, with a 10 in. suction in the after end of each tank, and a 6 in. suction in the forward end. Gate valves are placed close to each suction. At each bulkhead the pipe line is provided with a cast iron expansion toe and a division valve. All valves are operated from the spar deck through stems fitted with universal joints and guided in brass or lignum vitæ bushings. The piping is so connected up in the pump room that either main pump can pump from or discharge into any tank, or overboard. One auxiliary pump is connected with No. 8 tank on each side with a 5 in. suction main, and the other auxiliary pump is connected with No. 7 tank in a like manner. The forward ends of the main suction lines are connected above deck with a discharge opening and valve for loading, and the discharge from the oil pumps is led to a manifold on deck, with connections for either discharging or loading. For ventilating and drying the oil compartments, a 10 in. by 12¼ in. by 12 in. air compressor is provided in the pump room, and connected with the main cargo pipes. The oil pumps are also provided with a suction from the sea, and discharge into main condenser. Fire extinguishers are fitted to all oil tanks and fuel tanks, and are controlled by valves in the fidley hatch.

Electric lighting is used throughout the ship. Two 10 kilowatt general electric generators are located on the gallery deck in the engine room, and are direct-driven by "Curtis" turbines. All wiring, except in the living quarters, is run in iron conduits. An 18 in. search light projector is located on top of the pilot house.

The main engine is of the vertical inverted triple expansion type, having cylinders 28 in., 46 in. and 76 in. in diameter and a 54 in. stroke, developing power at 75 revolutions per minute. All valves are of the piston type, one for the high pressure cylinder and two for each of the others, and are operated by "Stephenson" links. The "Lovekin" assistant cylinder, type "A," is fitted to all valves, and by its use a considerable reduction is allowed in the size of the reciprocating part of this gear. The main engine is automatically controlled by an "Aspinall" governor. Receiver pipes and main exhaust pipes are of copper with steel flanges. The customary by-passes for admitting live steam to the intermediate and low pressure receivers are provided, the valves being operated from the working platform. A single cylinder steam reversing gear of the "all round" type and a hand reversing gear are fitted—either being thrown out of gear when the other is used. Relief valves are provided for each receiver and the top and bottom of each cylinder. Complete oiling and water cooling arrangements are installed.

Mounted on a suitable structural foundation is the main condenser (cylindrical steel plate type), with cast iron bonnets and tinned brass tubes. A vacuum of 27 in. can be maintained with circulating water at 86° F. A centrifugal pump with 14 in. suction, and driven by either one of two single engines, 8 in. by 8 in., will circulate sea water through the condenser. A twin vertical single air pump, having steam cylinders 11 in. by 18 in., and air cylinders

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22 in., is provided. The other principal auxiliaries are a "Weir" long stroke feed pump, auxiliary feed pump, a "Wheeler" auxiliary condenser with combined air and circulating pump, evaporator (thirty tons capacity in twenty-four hours), feed water heater, and "Mandigo" feed and filter tank.

Main steam pipes are of lap welded wrought iron; auxiliary steam lines and lines to all deck machinery are of copper with composition flanges. Stop valves are fitted at the boilers and expansion joints, traps and "Foster" reducing valves where necessary. The exhaust piping is of copper, with composition flanges. Leads from auxiliary and deck machinery pass to the auxiliary condenser and to the escape pipe on the stack.

The shafting is of the best open hearth forged steel, the tail shaft being 16¾ in. in diameter, and the thrust and crank shafts 15½ in. The crank shaft is in three interchangeable parts. A cast iron stern tube with lignum vitæ bearings is provided. The propeller is of the built-up type, having a cast iron hub and four "Parsons" manganese bronze blades.

Steam is generated by three single-ended Scotch boilers, designed for a working pressure of 185 lbs. per square inch. Each boiler has four 41 in. inside diameter "Morison" corrugated furnaces, flanged to independent combustion chambers. The total heating surface is 9,900 sq. ft., and the total grate surface 235 sq. ft. The ratio is 42·1 to 1. A forced draught system of the hot air type is installed.

Oil fuel (the "Lassoe-Lovekin" system) is to be used at the furnaces. At each furnace there is one oil burner, supplied from the settling tanks. Heated air from the forced draught system is delivered to the oil burners under low pressure by two rotary blowers, and vaporises the fuel. For starting the oil fuel system a 10 h.-p. coal-burning boiler is installed.

Double uptakes and stack are fitted. Boilers, engines, and all steam pipes are properly lagged with 85 per cent. magnesia covering, secured by sheet iron or other efficient method.

The list of spare parts for the machinery not only includes those required by the Bureau Veritas for a long voyage, but also a section of crank shaft, tail shaft, complete propeller, and, in fact, everything sufficient to make a complete disablement of the machinery almost impossible. The machine shop is provided with a 6-ft. turret lathe, a radial drill, benches and vices, and all of the machine tools are driven by electric motors.

This year the Gulf Company has inaugurated a number of new projects for the development of the business, and as larger quantities of oil are expected to reach Port Arthur it has been found necessary to increase the pipe line facilities and the number of oil carriers employed on the coast.

The Texas Company, started in 1901 as the Texas Fuel Company, is one of the most conspicuous successes in Texas and Louisiana. Brought into existence at the time when the most famous wells at Spindle Top were being drilled, its organisation was cleverly and carefully controlled by Mr. J. S. Cullinan, president, and Mr. Arnold Schlaet, vice-president. In this respect it differed greatly from the vast majority of the companies floated at that time of intense excitement. The fact that it has always remained financially sound, steadily grown in reputation, and gradually developed into a company of practically world-wide influence is directly due to the excellent business methods adopted at the start by its experienced founders.

When the Beaumont office was opened Mr. Cullinan and Mr. Schlaet decided that a New York branch was necessary, and from that time up to the present Mr. Schlaet has had charge of the business at 17, Battery Place, Whitehall Buildings, New York, where the European business has been developed.

The directors have taken a prominent part in all movements calculated to improve the status of the industry, abolish company and oil field abuses, and secure the passing of legislation for the protection of investments. At one time (1904) they publicly protested against reckless stock speculation and investments which made it difficult to secure the capital necessary to handle business on a legitimate or conservative basis. Mr. Cullinan told the Government "that it was doubtful, unless they had the assurance that investments would be safely guarded by reasonable legislation, if capital could be secured for further investment in pipe lines, refineries or oil transportation facilities in Texas." The lines on which this company has always been worked are indicated in the following statement, made by Mr. Cullinan:—

"It is our firm conviction that the needs of the oil business of Texas will not be fully met until legislation is secured that will permit of, in some manner, concentrating the facilities, energy and capital now engaged in senseless competition in trying to dispose of this product at tide-water, where the bulk of the production is now sold, into compact

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organisations with the necessary facilities and capital to husband the supplies and develop markets where the product can be disposed of at something like its real value. . . . I wish to call attention to the rapid change in conditions that has taken place in the past few years in the extensive development of oil in Louisiana, Indian Territory, Oklahoma and Kansas, all of which is now, to some extent, in competition with us for the surrounding trade. To meet these conditions, concentration of capital, facilities and experience will become necessary, and new capital and facilities must be added, new markets opened up, and the business developed on broader lines, if the State and those who are interested, producers or manufacturers, are to receive anything like reasonable prices for this product. Considering the short period in which this industry has developed, it is not surprising that the existing laws are found to be inadequate. We are asking for what, in our judgment, is necessary, if the business is to be developed and extended."

There is no doubt that the improved conditions under which the industry is being developed to-day are largely due to the pioneering work accomplished by Mr. Cullinan and his colleagues.

There is no branch of the business that has not been taken up by this company, which produces, refines and transports by rail, pipe line, barge and tank steamer; it has always paid dividends, and has a capital of £2,400,000 authorised, £2,000,000 paid up, £400,000 in the treasury, and a considerable reserve to enable it to carry out an elaborate programme in its different spheres of activity.

One of the company's trunk lines is from Sour Lake and Humble to Port Arthur; another is laid from Indian Territory *viâ* Dallas to the same shipping port, a distance of 650 miles; while a third is from Jennings to Lake Charles, approximately 100 miles. In addition to these trunk lines there are numerous gathering lines in the various fields and supplementary lines connecting the Port Neches refinery with the Port Arthur refinery.

The remarkable developments in Indian Territory have led the company to embark on another refinery undertaking which will deal chiefly with the high-grade oils of the Mid-continent fields.

Nothing shows the great confidence which this company has in the future of the producing territories and the expansion of the world's markets so much as the arrangements it is making to turn out special grades of oil suitable for different countries. It is arranging to put a line of lubricants on the market, and its experts are at work extending the new plant for the production of something absolutely special in the way of asphalts.

The company is also increasing the number of its oil-carrying vessels. At present the fleet consists of the *Florida*, *North Eastern*, *North Western* and *Northtown*, with a number of steel barges engaged in the Atlantic coast trade. It has stations at most of the chief distributing centres, the most important being at Philadelphia, Baltimore, Delaware and different ports in the south.

* * * * *

Oil ports have been brought into existence by the opening up of extensive producing territories and the arrival of many new tank steamers on the coast of California and Peru. Several years ago, before oil was discovered in the Santa Maria Valley, and the business of Port Harford was less than one-fourth its present volume, a breakwater was started by the Government, but for some unknown reason the work was suddenly dropped. The port (really the northern part of the San Luis Bay) is one of the few deep harbours south of San Francisco, which, in ordinary weather, is safe, but in stormy weather needs the protection of a breakwater.

It is felt that the marvellous expansion of the oil business makes it necessary there should be an extension of the wharf which the Government failed to complete. Much interest has been taken in the announcement that the county of San Luis is about to construct another wharf for the accommodation of oil vessels on the Union Oil Company's shore line at Ovila. The Standard Oil Company and the Union Oil Company have pipe lines from the Santa Maria fields to this port, where their barges and steamers load oil.

There is an important island trade in the Pacific Steamers and sailers trade regularly between oil-shipping ports and the Hawaiian Islands, a steamer being able to make sixteen round trips a year. Some tank steamers tow large oil-laden barges from the coast to these islands. For several years the Union steamer *Whittier* has traded to the islands with the four-masted oil-carrying barque *Fullerton* in tow. The *Whittier* (474,000 gallons) and the *Fullerton* (672,000 gallons) carry 1,146,000 gallons in a single trip. The *Whittier*, one of the smallest steamers on the coast, has a length of 250 ft. and a beam of 31 ft. 6 in. She has ten tanks, and, as she only draws

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16 ft., can enter coast and island ports where some of the largest oil carriers cannot go.

At Kibei, in the Hawaiian Islands, the water is too shallow to allow a vessel drawing as much water as the *Fullerton* to approach the wharf, and when she started to run in this trade she had to discharge into lighters. After she had made several trips a linen hose (8 in. in diameter and covered with waterproof material) was taken from the vessel to the wharf, buoyed up in the water by floats, which kept it from touching the bottom, but allowed it to be sufficiently submerged to be undisturbed by the action of the waves. In this way she was able to lie afloat in the bay.*

* * * * *

The two chief oil (importing) ports for the Chinese and Japanese markets are Hong Kong and Shanghai. Hong Kong supplies all the Chinese towns and provinces south of 25 degs. lat. N. and the Philippine and Formosa Islands. Kerosene is delivered in bulk as well as in tins—in bulk and in cases from Russia, Borneo and Sumatra, and almost entirely in cases from America.† It is a most difficult matter to discover exactly how much oil has been imported from the different countries, Hong Kong being a free port in which there are no import duties. For this reason there are no reliable statistics of a kind obtainable from the British Custom House authorities in India, but according to information obtained from leading kerosene dealers at Hong Kong—Foo-u, Fatkee, Ian-Cheong and Hoong-Siong—the imports of oil in bulk for a single year amount to some 60,700 tons from Langkat and Sumatra and 2,350,000 cases from America and Langkat, the Americans importing as much as 2,200,000 cases. The imports of Russian case oil have gone steadily down from 400,000 cases in 1899, and in 1901 70,000 cases, to absolutely no imports in the last year of which there is a record.

The chief and practically the sole importers of kerosene into Hong Kong for distribution through Southern China are the Standard Oil Company, the Shell Transport and Trading Company, the Royal Dutch Company, and the Langkat Company. Among the agents of the chief importing companies is the old-established English firm, Messrs. Arnhold, Karberg & Co., who have offices at all the treaty ports in China. The agents of the Royal Dutch Company are Messrs. Meyer & Co., Germans, who act for the Royal Dutch in the whole of China. The representative of the Langkat Company is Mr. George McBain.* At Hong Kong, just as everywhere else, the Standard Oil Company has its own offices and agents.

The larger part of the business in kerosene imported into Hong Kong for sale in the interior markets of China is carried on by native dealers, of whom the most important are the Chinese merchants. Most of the case oil sent into the country is sold at Hong Kong.

Besides tankage at Hong Kong the kerosene-importing firms have reservoirs in the coastal towns of China, to which the kerosene is delivered in bulk, either in small tankers from the Hong Kong tanks or direct from Borneo, Sumatra, and chiefly from Singapore. From the coastal markets it is impossible to send the kerosene inland in bulk owing to the absence of railways and the difficulties of transport by road. The storage installations have case works attached, and the "tin boxes" turned out at these places are of the same dimensions and appearance as those manufactured in America and at Batoum.

Mr. Meraboff mentions that, although the distance from Batoum to Hong Kong is only about half of what it is from New York, the freights differ to the extent of 7¾*d.* to 11¼*d.* per case from New York to 9*d.* to 1*s.* 3*d.* from Batoum.

Shanghai, the chief treaty port from which the greater part of the imports find their way to the remotest trading centres and coastal towns of China, is sometimes called "the London of the Far East." On account of its excellent geographical situation it has direct steamship connection, and carries on an extensive trade in manufactured goods and raw materials with almost every part of the world. It is on the river Wan-Poo, ninety miles from the sea. Its oil trade is one of great importance. In spite of

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* Mr. John D. Wardrop, eight years ago, in the Thames (European Petroleum Company's wharf), and others in different parts of the world, proved that a ship can be loaded or unloaded with a hose of this description at any point where landing is difficult, and it is also an easy matter for one ship to discharge oil into another at sea, this plan being frequently adopted by the *Petroleum* when she pumps fuel oil into the bunkers of battleships.

† A case consists of two tins containing 10 American gallons of kerosene, weighing about 65 lbs. To attract buyers the importers of bulk kerosene are said to fill up 68 lbs. of kerosene in tins of local manufacture. In the retail trade the oil is sold in a single case, a single tin, and even in wine bottles. The Chinese prefer to buy their kerosene in tins bearing Chinese labels. In Southern China the so-called low screw tin is preferred.

* The formation of the Bataafsche Petroleum Maatschappij and Anglo-Saxon companies will lead to changes in some of the chief agencies in the Far East.

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obstructive tactics, some wilfully conceived, the consumption of kerosene is steadily increasing. Opponents of the inland trade, particularly those interested in the vegetable illuminating oil obtained from home-grown pea-nuts and beans, circulate numerous notices and placards in Chinese in which they attempt to stir up the uncivilised masses against the use of kerosene, which they describe as "a product of human bones."

The bulk of the case oil is supplied to Shanghai by those countries which do business with the Hong Kong markets; it comes from America, Russia and Sumatra, a small quantity from Japan, and the bulk oil exclusively from Russia, Borneo and Sumatra.

The first deliveries of kerosene were entirely in cases from America. Russian case oil appeared in Shanghai during the second half of the eighties. The first appearance of Russian bulk oil from Batoum was in 1894. Sumatra oil made its first appearance two years later, when it was imported in cases, and in the following year it was delivered in bulk.

Transport is exclusively by the water-ways and steamers and sailing vessels, and while there are no special tankers or sailing vessels fitted to carry oil in bulk there are steamers and junks available for transporting case oil. On the coast of China hundreds of unsuitable vessels are employed to carry different kinds of petroleum spirit in cans. Some are old wooden sailers, while others are highly unsuitable tramp steamers. In some sailers the bulkheads are of wood, and when there is a leakage from the tins, sometimes as high as 8 per cent., no one need wonder that accidents occur. The Indian regulations applying to small local traders are not satisfactory. Owing to several accidents having occurred, one being on the steamer *Netherton*, practical men are advocating that vessels should not be allowed to run in this trade unless they have (1) a cofferdam between the hold and the stokehold, (2) a cofferdam or properly constructed oil-tight bulkhead between the forehold and chain locker or forecastle; (3) fine mesh wire screens on all ventilators; and (4) no electric wires leading to the hold. For the reputation of the industry, and also for the safety of those who work on these oil-carrying tubs, there ought to be no neglect of this subject in the chief oil ports of China and the Far East generally. This explains why the greater part of the oil reaching China in bulk *viâ* Hong Kong and Shanghai is re-shipped from these ports to the inland and coastal towns in locally manufactured tins. Kerosene in bulk is only consumed in small quantities at the ports where it is delivered direct from abroad; these are Hong Kong, Amoy, Swataw, and Hankow. The Shell Company and the Royal Dutch Company import bulk oil from Russia, while the Shell Company accounts for all the Borneo oil, and the Royal Dutch Company for all the Sumatra oil. Langkat oil from Sumatra is exclusively imported by the Langkat Company, while American oil is exclusively imported by the Standard.

The area at the disposal of foreigners at Shanghai is very limited, and for this reason the cost of land and leases is very high. The cost increased after the China-Japanese war, when, according to the Shimonosekki Treaty, foreign subjects, allowed to import duty free all kinds of machinery, started to erect at Shanghai cotton mills, silk mills, match works, and factories. The kerosene stores are built of stone, covered with corrugated iron roofing on wooden supports, hold from 50,000 to 200,000 cases each, and have a total capacity of 2,000,000 cases. The cost of a stone warehouse (corrugated iron roof and capable of accommodating 200,000 cases) is about £1,200. Stores constructed entirely of iron frames covered with corrugated iron, are obtained from England, and cost (including transport, freight and duty) about £800 in the case of a store capable of holding 50,000 to 60,000 cases.

Kerosene arriving at Shanghai is not subjected to a flash point test by the Customs, who only determine the specific gravity to find the number of gallons on which duty must be paid. The oil merchants of Shanghai have a very slight idea of what is meant by flash point, and even the Imperial Chinese Maritime Customs have been known to officially declare "that they do not know what is meant by flash point, and that they must not be asked to go beyond the determination of the specific gravity."

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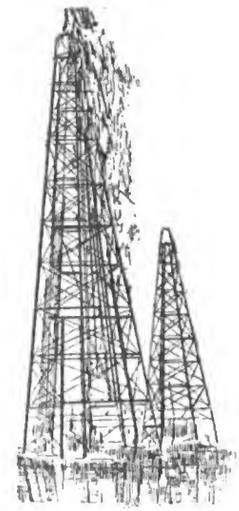

ALMOST perfectly organised and successful oil company is the well-known Steaua Romana, which has never lost its position as premier company in every branch of the Roumanian industry. It pioneered the export trade by erecting tanks at Giurgiu, where oil is loaded in barges for transportation to Regensburg, the centre of distribution for the markets of Southern Germany and Switzerland. The company has huge tank installations at Constanza, where it ships oil in tank steamers running to ports in the Mediterranean, Norway and England. There are very few companies, and there are certainly none in Roumania, which can claim such a remarkable record for enterprise and success as the Steaua Romana.

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Types of Texas Tank Steamers.

THE steamers shown below are well known in the oil trade. . . . They run between the Gulf of Mexico and the refinery ports on the north-east coast of America.

The *City of Everett*, a whale-back, built on the peculiar lines shown in the photograph, was one of the first tank steamers placed in the Port Arthur oil trade. Her destruction by fire in 1903 was one of the most sensational occurrences in the history of the Beaumont oil industry; the flames enveloped her from stem to stern, and when they died out she was completely gutted. Her owners, the Standard Oil Company, had her refitted and put back into the trade. This photograph was taken by Mr. Trost a few days after her return to Port Arthur.

The *Larimer*, one of the large fleet of oil-carrying vessels owned by the Gulf Refining Company, is 360 ft. in length, 46 ft. in breadth, and 24 ft. 4 in. deep, with a deadweight carrying capacity of 1,580,000 gallons. She burns oil, and steams from 10 to 12 knots an hour. The cargo space is sub-divided into eight compartments (one for fuel), while there is a further sub-division by an oil-tight centre line bulkhead extending to the top of the expansion trunk between the main and spar decks.

The Standard Steamer, *Captain A. F. Lucas*, built by Messrs. W. R. TRIGG & Co., Richmond, Va., U.S.A., in 1904.

[*To face p. 138.*

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CHAPTER XV.

Oil Ports in the making. Chiefly about Nigeria and Trinidad.

THIS country has some oil ports in the making, and these are too important to be overlooked. It is becoming more obvious every day that the most active and widest possible expansion of the oil fields of the Empire is a need of the times, both ashore and afloat. In less attractive covers I have frequently pointed out that the early development of our Colonial oil sources is a matter of Imperial importance, and one which demands the most serious attention of those departments of the Indian and Colonial Offices concerned in the development of our Imperial mineral resources. New oil fields create new towns and shipping ports.

Some trade experts say it is possible to have an over-production of oil. This is a harmful and foolish mistake. There can only be over-production temporarily, and, only then, locally, but never in relation to the constantly growing needs of the world. The field is an unlimited one, and if all the oil produced were converted into fuel it would only come up to 5 per cent. of the world's output of hard fuels.

Professor Zaloziecki recently contended, in a communication I received from him, that over-production is not an evil, but merely "a passing incident in the life of the industry," something that can be improved by the energetic extension of the use of the endless variety of products obtainable from crude. "What we want," he wrote, "is an extension of the present fields of consumption." Petroleum is a liquid coal, and as such its use should be unlimited and the extension of its consumption purely an artificial business.

Now that oil as a fuel has been permanently adopted by the Admiralty on all kinds of warships, there are commercial and national reasons why no time should be lost in developing the oil resources of the Empire.

Important officials at the Admiralty are known to favour the development of a Colonial oil industry, and it may be taken for granted that, so ar as the Government are concerned, everything possible will be done to assist legitimate and properly financed enterprises to produce liquid fuel for the use of the Empire. No one need be surprised if in a few years a fleet of oil-carrying steamers on the lines of the *Petroleum* and *Kharki* are built, or if we witness the erection of a complete ring of Colonial oil storage installations. So great is the progress made with liquid fuel that we may expect to see in the next great naval war, not only many vessels burning oil, but every fighting fleet accompanied by fast-steaming oil-carriers.

A powerful argument employed to enlist the practical sympathy of the Colonial Office is that it will be to the advantage of the Empire if it is able to rely on a Colonial oil supply, and it is obvious that British oil-burning warships on Colonial stations will lose nothing in efficiency and reliability if the Admiralty can reckon on adequate supplies from either English or Colonial companies.

Many foreign fields, particularly those of Russia and Galicia, and even Roumania, are not attempting to supply liquid fuel for the British Navy. Borneo, California and Texas contribute the largest quantities to the maritime needs of the world; these supplies, in no way equal to the demand, can be best and most safely augmented by a Colonial output.

The oil resources of the Empire, if we omit those of India and Canada, are practically undeveloped, but there is a growing expert opinion that the Colonial yield of oil will be very considerable in a few years' time. The British island possessions, which constitute the oil-bearing part of the Empire, include the much-troubled and ancient colony of Newfoundland, the sister islands of Trinidad and Barbadoes, and Australia and New Zealand, while we know something of the efforts which are being made to develop oil lands in South Africa, the Gold Coast, Nigeria and other parts of our possessions.

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In the oil fields of Burmah, British enterprise, led by the successful Burmah Oil Company, has completely modernised the primitive methods of the time of Theebaw and created a great and vigorous industry with all the necessary facilities, pipe lines and tank steamers for the transportation of a vast production of petroleum. In Assam British enterprise has laid the foundation of a promising business on lines similar to those which have worked so well in Burmah.

In Canada we find some of the world's best producing fields, and the wells, if they are not great producers, cost little and yield for years. There are oil fields near tide-water, and in a few years there ought to be some oil ports in New Brunswick.

Holding these opinions, I am naturally anxious to devote at least one chapter to developments in several parts of the Empire where we have oil ports in the making.

* * * * *

"By night we passed New Town. . . . After my departure from the coast it was inspected by Mr. Grant, who sent home specimens of bitumen taken from the wells."

"Lastly, the humble petroleum . . . has been found in the British Protectorate about New Town."

These two extracts are from "To the Gold Coast for Gold"—the joint work of Sir Richard Burton and Commander Cameron—issued in 1883, and constitute the first authenticated allusions to the presence of a possible oil field in West Africa, the deposits in question being situated on the Appolonia Coast in the Gold Coast Colony.

In view of the enormous importance attaching to the development of sources of oil fuel under British control, it is an extraordinary circumstance that eighteen years were allowed to elapse before the slightest effort was made to turn these oil indications to account. Even then, the efforts of those into whose hands the Appolonia oil area had passed were of such a half-hearted nature that they speedily fell into abeyance, and with them went all hope for the time being of finding oil in commercial quantities in that part of the African continent.

Fortunately energetic influences were soon at work with the same object in view in another part of West Africa—Lagos and Southern Nigeria—and it is solely to these that the modern inception of the West African oil fields is due.

Some years ago, Mr. Hawkins, while engaged in a survey for the erection of a new telegraph line for the Nigerian Government service, experienced considerable difficulty in making and keeping intact the necessary holes for the encasement of the poles, some of these rapidly filling in before the poles could be placed in position. This was due to the plastic nature of the soil. He promptly secured samples of the soil, some of which were submitted by the Lagos Colonial Secretary to the Imperial Institute with satisfactory results, while others were brought by him under the notice of Mr. George Macdonald, who, fully realising the vast possibilities of the discovery, proceeded to follow it up with alacrity, his efforts being ably seconded by his colleague, Mr. Henry John Brown.

The samples from the deposits were first of all treated entirely from an asphalt point of view, but in the subsequent investigations into their commercial value by Mr. R. H. Stanger, Mr. D. A. Sutherland and Sir Boverton Redwood, it was Mr. Macdonald who looked beyond the asphaltic aspect and was not satisfied until repeated experiments in the laboratory had clearly indicated oil, thereby prompting the inspiration that these deposits were not of purely asphaltic origin, but represented the possible overflow or leakage of petroleum from subterranean or other sources.

Meanwhile the late Mr. Bernard A. Collins had been sent to make an exhaustive examination of the Nigerian areas. In all, he framed three reports, each succeeding one being more favourable than its predecessor, while his views were fully endorsed in a report by Mr. A. H. Harrison, another expert.

The deposits investigated by Mr. B. A. Collins occur about twenty-five miles from the shipping port of Lagos, within twelve miles of the Lagoon shore, and have been found interspersed over a wide area, the oil zone apparently approximating three hundred miles in length by fifteen miles in breadth, in the same latitude, viz., between 5 and 10 degrees North, as the Appolonia area, the Tano region, the great asphalt lake of Trinidad, and the bituminous territories of Venezuela.

Summarised concisely, the bituminous grit of the Nigerian deposits, where proved by bore holes, lies about 20 ft. below the surface, has an average thickness of ten ft., and is often prevalent in the semi-liquid tar state.

As late as August, 1906, and just before his untimely death, Mr. Collins, while actively engaged in developing one of the areas located by him, stated

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in his reports that he had struck an area, the richness of which from a bitumen point of view, far exceeded anything he had previously seen in the Colony, and that in travelling through the bush he had seen enough in all directions to warrant his stating that there were millions of tons of commercial bitumen to be obtained from one square mile, quite apart from the petroleum which he had no hesitation in saying would also be found there.

In 1905 the oil indications were sufficiently promising to attract the attention of Mr J. S. Bergheim, now one of this oil field's staunchest supporters. To effectually clinch matters he sent out his own expert, Mr. Frank Drader, who not only confirmed Mr. Collins's reports, but came to the conclusion that the bitumen originated from an oil source somewhere in the immediate vicinity of the asphalt deposits. He then started boring with hand tools, and, from the indications, formed the opinion that he had located both the source of the oil and its lay.

In order to turn the bitumen to account, a number of stills, capable of treating thirty-five tons per day, were sent out; while, as to the oil, two of the finest drilling rig equipments obtainable were despatched to the property.

In this connection I am aware that Sir Boverton Redwood is at one with all the pioneers of the movement in believing that the actual location of stores of petroleum is only a matter of time, provided that the sinking of wells is undertaken in an intelligent and judicious manner.

Some exclusive information as to the nature of the Nigerian deposits should prove both interesting and instructive in a work of this kind. Authorities declare :—

(*a*) They are apparently larger in extent than those of either Trinidad or Venezuela. (*b*) The bituminous contents of the deposits are greater than in the former and less than in the latter. (*c*) Their softening and flowing points are lower and their organic matter greater than in the case of the deposits of the two other countries. (*d*) Their inorganic matter is less than that in the Trinidad and much greater than in the Venezuela deposits; and what is the most important difference of all (*e*), their proportion of sulphur is lower than in either of the other two.

Experiments by some of the best chemists of the day showed that the crude Nigerian material consists of 35 per cent. oil, 36 per cent. coke, 18 per cent. water, the remainder representing the loss; while results by distillation gave :—

	Per cent.	Specific Gravity.	Flash Point.
Burning oil	8·8	·841	180° F.
Intermediate oil	13·5	·897	235° F.
Lubricating oil	28·8	·938	350° F.

The residue containing 6·6 per cent. of bitumen, 38·8 per cent. of still coke, plus the loss on distillation.

The experiments indicate that when the crude bitumen can be distilled in quantity in an apparatus specially devised for the purpose, improved products with crystallisable paraffin will be obtained.

But quite apart from the bitumen aspect, Mr. Collins, in vindication of his belief in the existence of an extensive oil zone in Nigeria, reported geologically as follows :—

"(*a*) The deposits of bitumen are due to the horizontal movement from the north of the mineral tar resulting from the natural distillation of petroleum. (*b*) The bitumen underlies all the hills in a stratum of sand and gravel, and where denudation has taken place, the outcrops of hard shale-like bitumen invariably cap the more plastic material below. (*c*) It is now a well-known fact that although petroleum may be found in all formations upward from the Silurian, the two in which it is worked on commercial lines are the Silurian (as in Pennsylvania) and the Tertiary (as in Russia, Java and South America). (*d*) Taking these facts into consideration, and basing a calculation upon the enormous body of bitumen existing to the south, which is nothing more than the residuum of the distillates (by chemical heat or otherwise), I have no hesitation in declaring that to the north an anticlinal formation will be found in which petroleum of high grade will be encountered. (*e*) I believe that the northern limit of the area will approach very closely the formation whence the petroleum came in the first instance, and that the deposit results from petroleum that has moved, after condensation, through a porous sandstone formation lying between the upper shales and the lower petroliferous rock."

Let us now retrace our footsteps to the oil region in the neighbourhood of Appolonia in the Gold Coast Colony, and of that near the Tano River, on the French Ivory Coast.

This is presumably a continuation of the oil zone that extends from Nigeria in the east to Liberia on the west. It was only in keeping with Mr. Macdonald's broad and go-ahead policy that as soon

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as he had secured proof of the possible existence of this extensive oil zone, he should endeavour to obtain control of every promising oil property along the theoretical oil line. His efforts have been so successful that he has now obtained for his group, not only the two properties already mentioned, but a further area in the Gold Coast Colony, and, in addition, has secured the oil rights over a large territory now being developed in the important Portuguese West African Colony of Angola.

While he has been the prime mover in this oil enterprise, it would have been quite impossible for him to have moved so rapidly and to such excellent purpose without the invaluable assistance of his colleague, Mr. Henry John Brown, and such experts as Sir Boverton Redwood, Mr. J. S. Bergheim and other oil enthusiasts. To-day, the oil zone is no longer in the tentative stage, but has practically crystallised into a hard fact.

The Tano area is situated on the French Ivory Coast close to the Gold Coast boundary, and is twelve miles from the French port of Assinie.

The geology of the country is a soft, dark-red sandstone, impregnated with oily matter and apparently overlaid with limestone, which for the most part is full of marine shells, the formation generally being somewhat similar to that of Baku on the Caspian Sea. Moreover, the lagoons in each case partly contain salt water and appear to have been formed in the same way.

Such is the opinion of Mr. D. P. Brown, who has had considerable experience on the Baku oil fields, and who went out to report upon the Tano property. He located bituminous beds, sometimes of a liquid tar character, and usually containing roots and other decayed vegetable matter, at ten different points, covering a frontage of four miles on the Tano Lagoon shore. The beds, as exposed on the surface, vary in length from 100 ft. to 300 ft., and have an average thickness of about 2 ft. They cover a very large area, and in Mr. Brown's opinion represent the residue of outbursts of petroleum in ancient times.

Although perfectly satisfied with Mr. Brown's report, in order to be on the safe side, Mr. Bergheim deputed another expert, Mr. Bukojemski, to make an independent report. In this he more than confirmed Mr. Brown's opinion, stating that the oil proposition was a good one, that the oil "shows" were conclusive, that the oil line was very broad, and that he had located the wells and made all the preliminary arrangements with a view to commence drilling without delay.

Chemical analyses of the composition of the oil samples obtained from the bitumen by Mr. D. P. Brown, were duly made by Dr. J. Lewkowitsch, who in his report said:—

"(*a*) These oils throughout offer no difficulty in distilling and are readily refined. (*b*) No sulphuretted hydrogen was noticed throughout all the distilling and refining operations, so that the oils may be considered as practically free from sulphur products. (*c*) There is practically no paraffin scale present. The most remarkable characteristic of the crude oil is that it yields lubricating oils of exceedingly high specific gravity, such as are not met with in the market. These oils should find a ready market. (*d*) The absence of petroleum ethers of very low specific gravity in conjunction with the absence of sulphur would, in my opinion, point to the conclusion that the bitumen from which the crude oils have been obtained is not of an asphaltic nature, but is the remnant of a natural crude petroleum which has permeated the sands, whilst the lowest boiling 'spirits' have evaporated off by a natural process."

Sir Boverton Redwood, after making some satisfactory investigations, said:—

"It is evident that saleable commercial products could be manufactured from the raw material, but I agree with Mr. Brown in regarding the deposits of bitumen as of value mainly in regard to the evidence they afford of the existence of petroleum in the district."

The Appolonia area is quite close to that of Tano, about sixty miles from the Tarkwa banket mines, and has much in common with it. The report of Mr. Brown leaves no doubt as to the value of the area. His examination extended over a wide range of country, and upon this he found numerous pools of liquid tar, connected and joined together by bodies of solid bitumen, the whole forming a very large bituminous deposit, sometimes smelling very strongly of gas.

Mr. Bukojemski confirmed this. "Formation favourable, no sand rock, but clay very promising; a fair oil proposition; oil line very broad; shows, both oil and gas, conclusive," he recently cabled.

On either side of this area are the West Africa oil and fuel concessions, upon which petroliferous indications also abound.

It was in this neighbourhood that Sir Richard Burton first made the discovery that petroleum

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existed in West Africa, and although Nigeria has so far come into most prominence, the inference is that the bituminous deposits of both regions represent the residues of the same zone of oil.

It is estimated that one hundred tons of the crude material would yield by dry "cracking" distillation, the following results :—

	Tons.	Value per ton. £ s. d.	Gross value. £ s. d.
Burning oil ...	3·3403	7 10 0	25 1 0
Gas oil ...	13·9705	3 10 0	48 17 10
Spindle oil ...	17·5000	7 10 0	131 5 0
B. Cylinder oil, No. 1 ...	2·9010	9 10 0	27 11 2
B. Cylinder oil, Nos. 2, 3, 4...	29·8445	10 10 0	298 8 10
Paraffin wax ...	0·5400	27 0 0	14 11 7
Coke	9·4500	0 10 0	4 14 6
	77·5463		£550 9 11

The above results were obtained by Dr. J. Lewkowitsch after subjecting the oil to dry distillation with the aid of superheated steam.

There will always be a market for the oil close at hand. The rich and expanding Gold Coast mining industry is badly in need of a cheap fuel. Coal is at present delivered to the mining centres at an inclusive charge of upwards of 40*s.* per ton, with a much higher rate at the more distant mines.

Although wood fuel is somewhat cheaper, a regular supply cannot always be counted upon, owing to the uncertainty of the labour employed. Moreover, in time, the forests of timber in the mining districts will become exhausted, and the farther afield the mines have to go for their timber the higher will be the cost of obtaining it.

It would be easy to lay pipe lines from Appolonia or Tano for the conveyance of the oil to Taquah. Consequently, the enormous advantages accruing to the industry from the actual presence of oil in commercial quantities on either area will be apparent to the merest observer.

The oil could also be used on steamers and Government railways, and, in fact, in a variety of ways obviously conducive to the prosperity of these colonies. As it is, the British, French, Portuguese, and German West African colonies import coal fuel, and notably so in the case of France, which possesses an extensive railway system, and uses many thousands of tons of coal annually.

As it is only a little more than a year ago since the oil fields came into prominence, their development will naturally take time. If, however, events move as rapidly as they have done since last October, it is practically safe to prophesy that in two years the oil fields will become a sterling actuality, quite apart from the value of the deposits from a bitumen point of view.

Sufficient has been said in proof of the potential value of the West African oil fields. No less than ten experts—Sir Boverton Redwood, Dr. J. Lewkowitsch, Messrs. J. S. Bergheim, D. P. Brown, V. Bukojemski, B. A. Collins, Frank Drader, A. H. Harrison, D. A. Sutherland and R. H. Stanger—have delivered judgment in favour of the deposits, either from their own personal knowledge of the country or from the facts and samples submitted to them.

Their position in the matter has, however, been distinctly subordinate to the leadership of Messrs. Macdonald and Brown, who not only started, but have intelligently and skilfully organised, a movement which at no distant date is destined to have far-reaching results on the civilisation and commercial prosperity of West Africa.

* * * * *

"It is incumbent on every one who has any power or influence to do his utmost to see that the oil fields of Trinidad are fully and properly developed, not for the benefit of the Colony alone, but for the benefit of the British Empire."—RANDOLPH RUST.

Trinidad, already an oil-producing island, gives great promise of early taking part in the world's huge business of oil transport. This is a fact of considerable importance to the British Admiralty, just as it is one of interest to all who are concerned in the early increase of the world's yield and movement of oil. Trinidad is an island of immense possibilities, and I am convinced that there are in this small Columbus-discovered spot (it is only 1,750 square miles in extent) large tracts of oil-bearing territory; indeed, it would be practically impossible to discover a small island so prolifically dotted with unmistakable indications of the existence of oil and bitumen.

What makes the island such a valuable asset in the hitherto neglected British part of the business of oil production is the fact that the work done during the past few years has produced most encouraging results. In a word, the prospecting programme, so ably arranged and energetically carried out by the Oil

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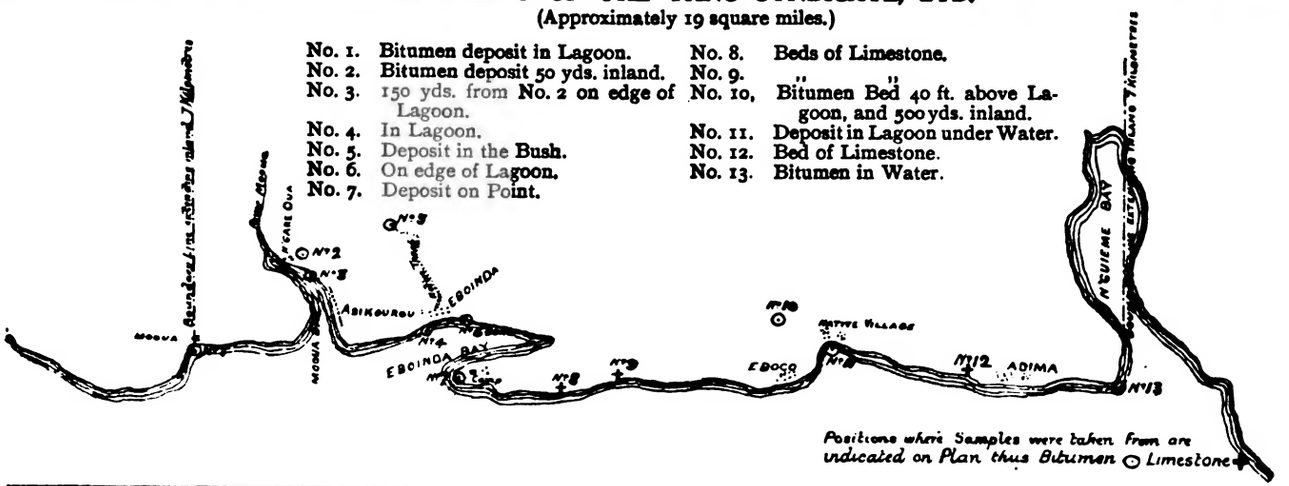
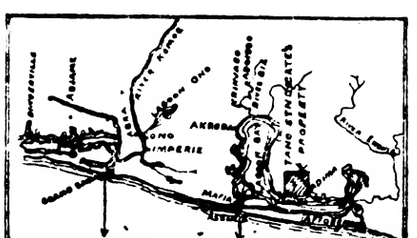
PROPERTY OF THE TANO SYNDICATE, LTD.

(Approximately 19 square miles.)

No. 1. Bitumen deposit in Lagoon.
No. 2. Bitumen deposit 50 yds. inland.
No. 3. 150 yds. from No. 2 on edge of Lagoon.
No. 4. In Lagoon.
No. 5. Deposit in the Bush.
No. 6. On edge of Lagoon.
No. 7. Deposit on Point.
No. 8. Beds of Limestone.
No. 9. " "
No. 10. Bitumen Bed 40 ft. above Lagoon, and 500 yds. inland.
No. 11. Deposit in Lagoon under Water.
No. 12. Bed of Limestone.
No. 13. Bitumen in Water.



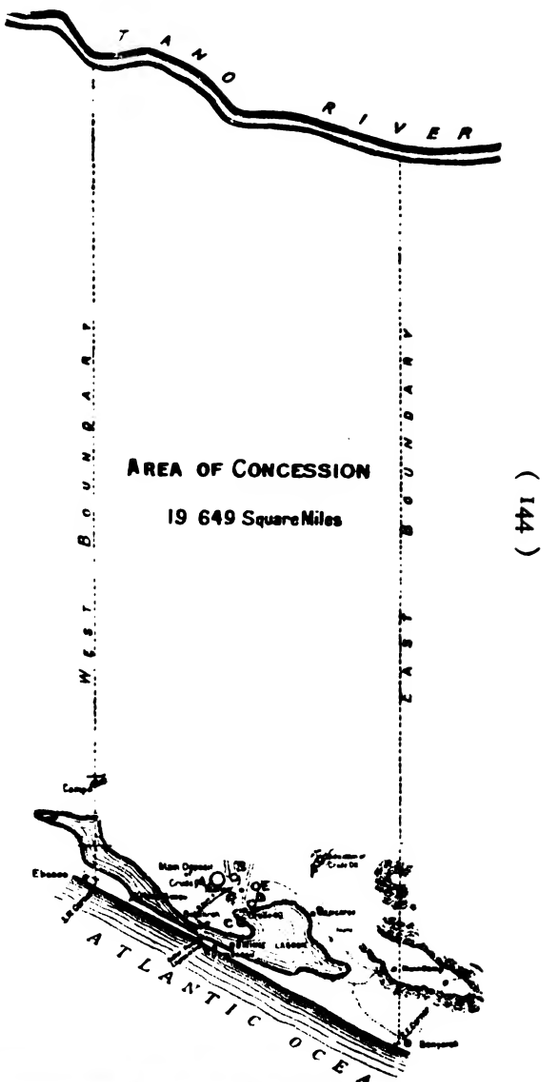


TANO LAGOON

No doubt when the existence of oil is proved upon these areas, the question will arise as to the existence of suitable oil shipping ports in that part of the world. A glance at the map will answer this question better than any words can describe. For the Ivory Coast, the port of Half Assinie will be a good one in the Côte d'Ivoire, while on the Gold Coast there is the excellent port of Sekondi, with the terminus of the Sekondi-Kumasi Railway, where all necessary facilities will be found. In Nigeria the well-known port of Lagos will be the centre, and the Government at this place are spending a large sum of money in dredging the bar to make the water-way available for large steamers. Lower down, some five degrees south of the Equator, there is the excellent port of Angola, where all facilities will be found, either for the storage or shipment of oil, and which will be quite competent to deal with oil supplies that may come from the Portuguese West African territory.

THE APPOLONIA OIL CONCESSION.

(Property of the West African Mahogany, Petroleum, and Gold Co., Ltd.)



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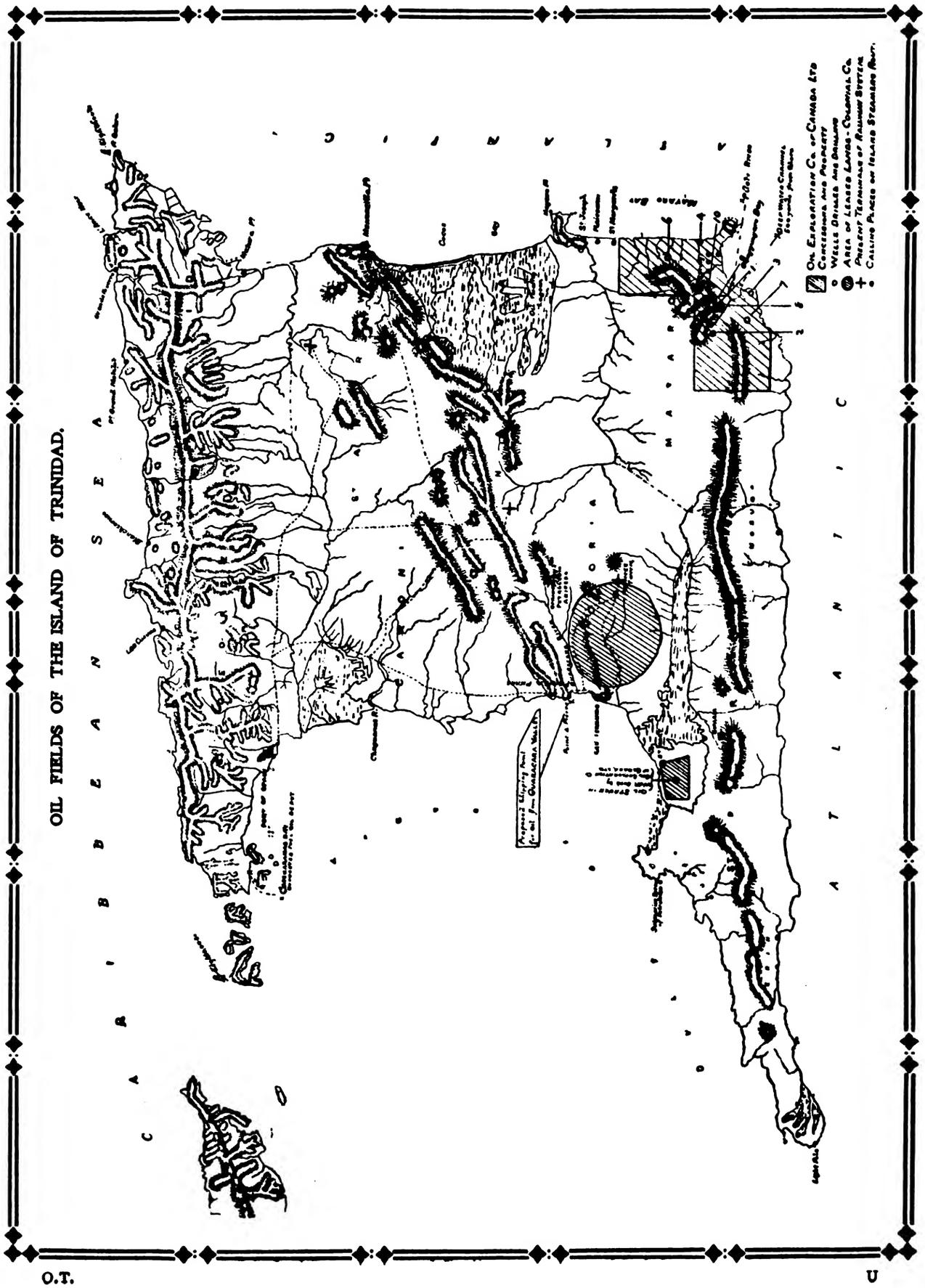

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Exploration Company of Canada, Ltd., of which the well known firm of Walker Bros., of Walkerville, Ontario, are directors, has proved that oil of a very fine quality underlies more than one large tract of land on the island. The map which I have specially prepared for this book converts these few general sentences into matter-of-fact evidence concerning the extent and importance of the discoveries which have been made during the past two or three years. The two authorities whose statements carry most weight on Trinidad oil subjects are Mr. Randolph Rust and Mr. Cunningham Craig; the first-named recently delivered a lecture in London on Trinidad petroleum, and was able to speak as the pioneer of modern developments, while Mr. Craig is entitled to be heard on the ground that he is the geologist who has conducted the latest surveys on behalf of the Government.

In this work I am limited to a discussion of the possibilities of the early exportation of oil, but before I go into certain new facts connected with the marine advantages of the oil business on the island a little history, followed by a few lines of comment on the nature of the discoveries already made, may be pardoned.

The story has often been told that the Trinity Hills, three in number, which look down upon Guayaguayare Bay, were the first land sighted by Columbus when he discovered the island on Trinity Sunday in 1498, and led him to christen the island Trinidad. It is an interesting fact that the only properly developed oil field on the island, so far, lies at the foot of these famous hills. This oil field—the Guayaguayare-Mayaro field, to give it its full name—is not the only one on the island; large deposits of oil are believed to exist on the west side also, and wells are now being drilled at Guapo by the Trinidad Petroleum Company, while a trial well drilled on "Aripero" estate by the Canadian Company struck oil of a similar quality to that secured at Guayaguayare, which is forty miles away as the crow flies.

Mr. Rust, when he recently told the story of his first search for oil on the island, said:—

"We found there was a great mud volcano, 'Lagoon Bouff,' and in the forest we found numerous little oil streams; they were running all over the place. In a ravine, two or three hundred yards in length, the water was covered with oil. We also found petroleum gas blowing out in large quantities in numerous places throughout the forest. I lit natural gas in October and it burned until we put it out in the following March; and the oldest hunters told me that as long as they could remember they had always found the gas in great quantities, showing that there must be a huge deposit of petroleum below the surface."

Respecting the western coast, Mr. Craig has stated that many of the most promising districts lie on the western coast of the Colony, on lands already partially opened up by roads and railways, and within easy reach of the calm waters of the Gulf of Paria, where no considerable engineering difficulties will be met with in laying pipe lines, building jetties and shipping the petroleum. It is on the west coast that the celebrated Pitch Lake is situated. This is merely an enormous outcrop of petroleum, from which in the course of ages all the volatile oils have been taken off by Nature, leaving the heavy residuum of bitumen.

He has also put it on record—"That it will be possible to refine the oils so as to make a large percentage of fuel oil, which will probably prove the most profitable branch of the industry in Trinidad. Situated as the Colony is, with a magnificent harbour, it cannot fail to become in the near future a very important centre of trade and shipping; and if, as we are assured on all hands, oil fuel is to be the fuel of the future for ships, it will be possible to sell every gallon of the fuel oil produced in Trinidad without coming into competition with any of the great oil companies of other countries. The demand for petrol is steadily increasing, and the percentage of it in Trinidad oils should also find a ready sale, while lubricating and illuminating oils can be disposed of in the Colony, to the neighbouring islands and at home."

The British Admiralty alone would be a very large consumer, and the source of supply being on British territory the oil would be available in war time, when oil fuel from foreign parts would become contraband of war.

From the latest reports published by the Government of the Colony, we learn that the oil fields are of great extent—"at a conservative estimate, five hundred square miles," according to Mr. Cunningham Craig—and are likely in the near future to be a considerable source of supply, not only of petrol and illuminating oils, but of what is of greater importance—fuel oil for the British Navy.

The island of Trinidad is one of Great Britain's most lovely tropical possessions. It is situated about 10 degs. north latitude, between the 61st and

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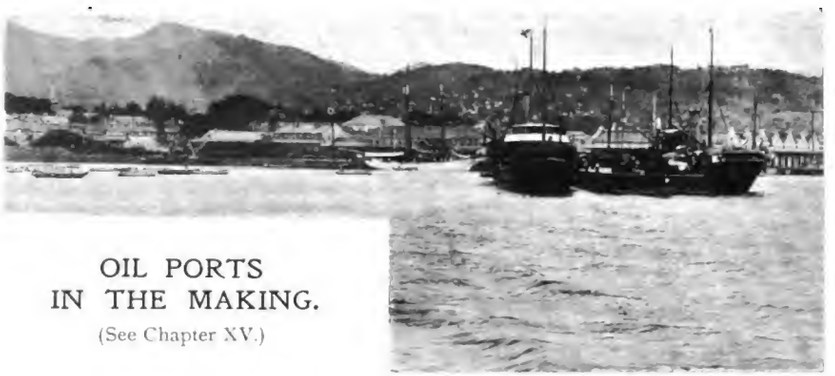


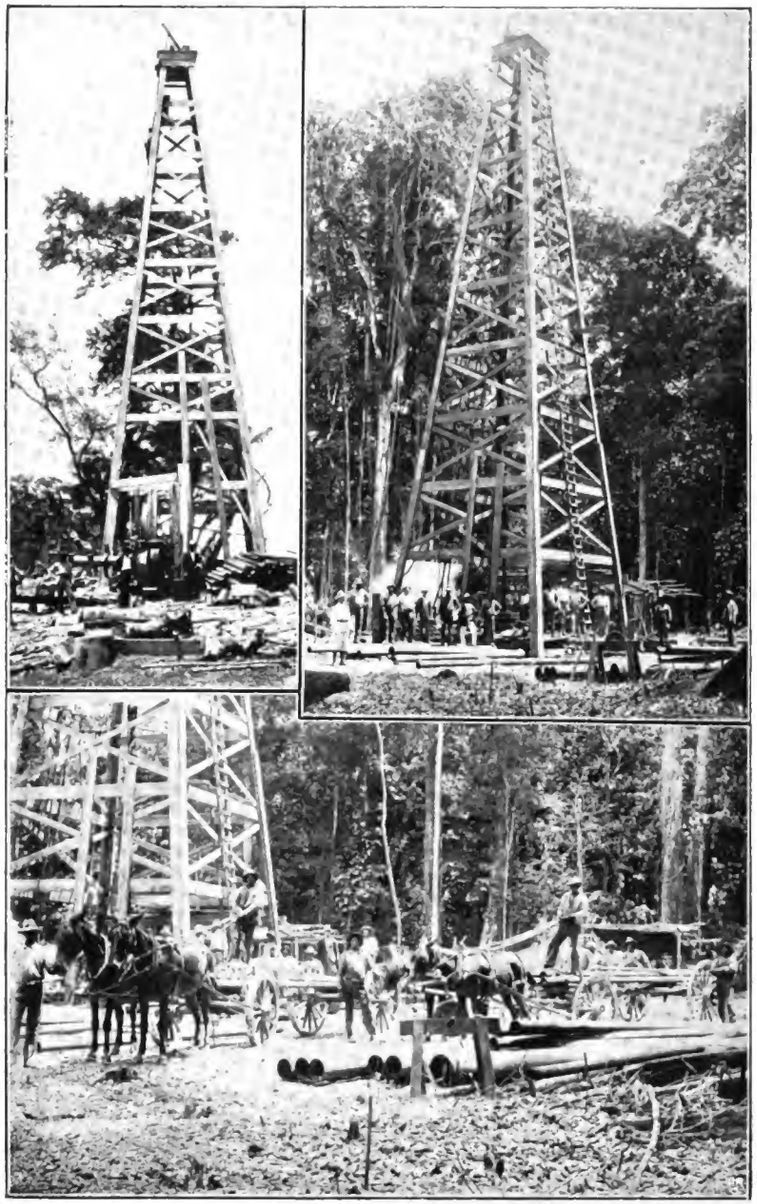
OIL PORTS IN THE MAKING.

(See Chapter XV.)

PORT OF SPAIN.

On the left, some of the pioneer oil well drillers on the Island of Trinidad. One of the ten wells of the Canadian Oil Exploration Company. Below (on the left), Guayaguayare Bay, the probable shipping point for the Guayaguayare Mayaro Oil Field. There are four-and-a-half fathoms of water within 500 yards of the beach.

On the right, some of the wells of the Canadian Oil Exploration Company.



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62nd degs. west longitude, in the Caribbean Sea, off the north-east coast of Venezuela, from which it is separated by the Gulf of Paria. It is the second largest island of the British West Indies.

Most of the exploration work has been carried on at Guayaguayare, in the south-east corner of the island, and Guayaguayare Bay will, in all probability, be the shipping port for the oil from the Guayaguayare-Mayaro oil field. The bay is well sheltered from the prevailing east winds by Galeota Point, and a deep-water channel (26 ft. deep) runs to within 500 yds. of the shore, opposite to the mouth of the Pilote River. Several of the wells have been drilled on the beach itself, and the furthest inland is not more than one-and-a-half miles from the sea, with a fall of some 25 ft. from the mouth of the wells to sea level.

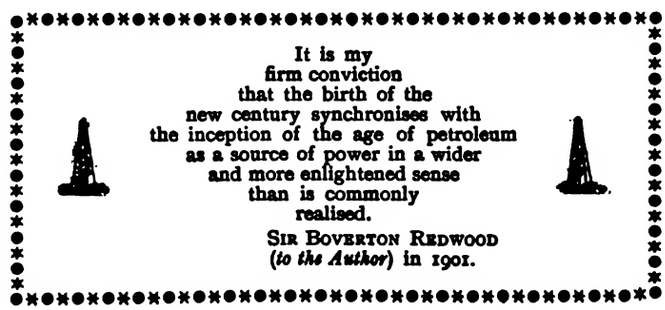
Shipping facilities in the shape of a pipe line carried out from half to three-quarters of a mile by a pier to deep water is all that is needed to make Guayaguayare Bay an excellent loading-place for tank steamers.

The oil from the western and south-western fields can easily be pumped to shipping places on that side of the island, inside the Gulf of Paria, and when sufficient oil for transport is discovered piers will have to be run out to deep water; although when the oil deposits in the neigbourhood of Sanfernando are tapped, Pointe-a-Pierre, with its deep water channel close in shore, should prove an excellent shipping place.

The harbour of Port of Spain will probably be employed to some extent for the storage of fuel oil, but an ideal spot for this purpose will be Chaguaramas Bay, some six miles to the west of Port of Spain, where excellent natural facilities exist. There is deep water close in shore in the bay, which is well protected from any winds that blow, while heavy guns mounted on the small islands adjacent would command the entire bay, making this in every way an ideal and safe place for the storage of fuel oil for the British naval vessels.

Geographically, Trinidad is exceedingly well situated for the distribution of oil, and, being out of the hurricane zone, shipments can be made with safety all the year round. When the Panama Canal is opened it will be a far more important colony than it is to-day, as all traffic going south to Brazil and the Argentine will pass that way, and, lying as it does at the mouth of the Orinoco River, will still further serve as the transhipping port for the interior of Venezuela. Finally, Trinidad is certain to be of great importance in the production of petroleum, on account of its ability, when the fields are further developed, to supply fuel oil to the mercantile marine and to the war-ships of the Empire.

As a winter resort its climate is of the finest, and the island already attracts large numbers of tourists from Europe and the United States. The population numbers some 310,000. The chief city is Port of Spain, the population of which is 60,000.



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DR. JAMES M. ROBERTSON has described a visit to the oil wells of Burmah in 1879. In Upper Burmah he inspected the "King's Well," which had for centuries yielded large quantities of oil. On the voyage up the river Irrawaddy he found that the odour of petroleum pervaded the atmosphere. At the wells he saw a fleet of small oil-laden schooners and barges, and the shore was covered with great earthen jars of oil.

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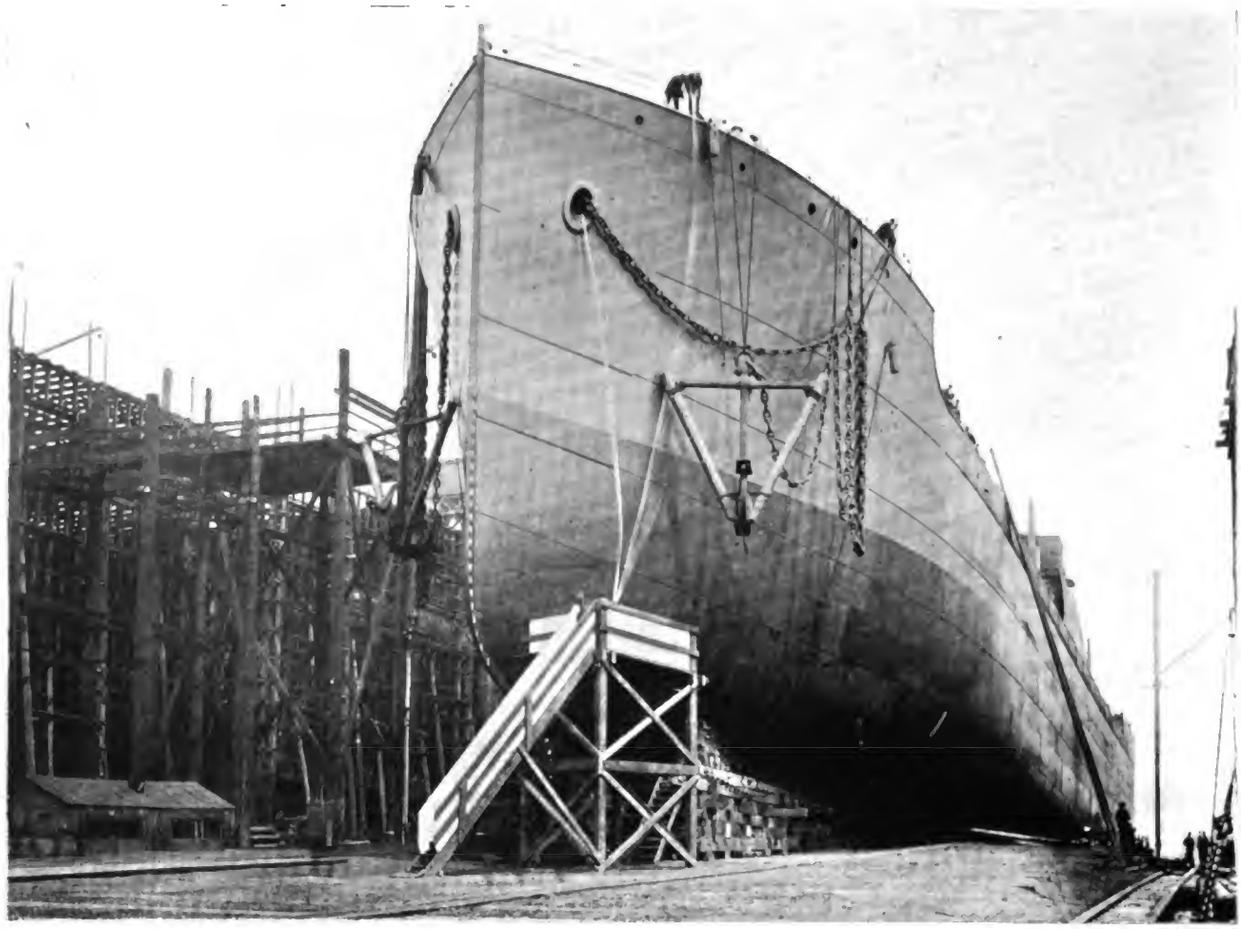
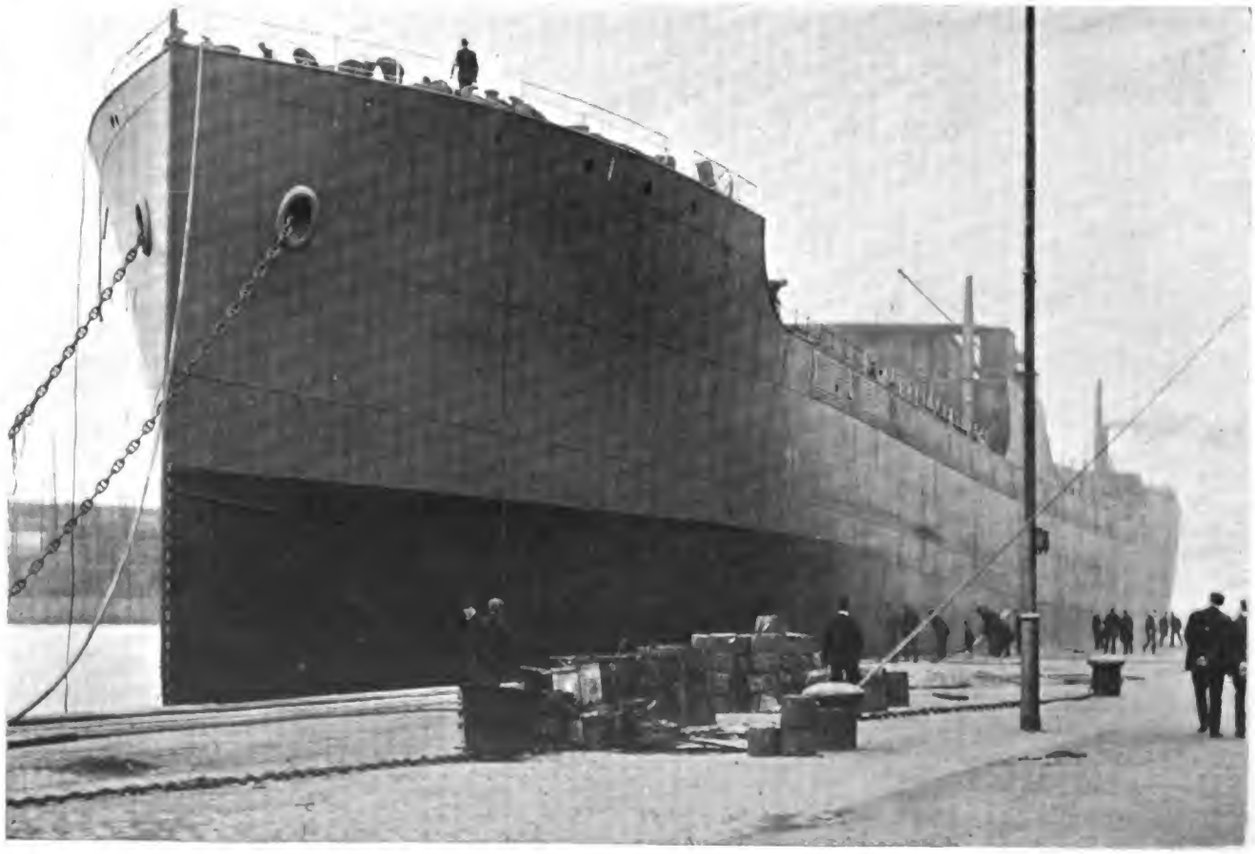
The TWIN-SCREW OIL-CARRYING STEAMER IROQUOIS. *Owners: The Anglo-American Oil Co., Ltd.*



BEFORE LAUNCHING.



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CHAPTER XVI.

Tank Steamers of the Present Year (1907). Orders for new tonnage. Sir Marcus Samuel and the British Government.

THIS chapter, which brings the historical part of the British section of this volume to an end, has been kept open until within three weeks of the day of publication, and what I am writing at the beginning of August will be read in different parts of the world in the early days of next month.

There are two reasons why I mention this fact. I suppose there are few illustrated technical works of this magnitude that will compare with this one in rapidity and excellence of production, and the fact that I am permitted to embody this chapter in the month of publication speaks volumes for the up-to-date methods adopted in the printing office which has given birth to this latest addition to the Anglo-Saxon section of the literature of an industry which has been contributed to by authors in many different countries. The second reason why I refer to the despatch with which this book has been produced is this, that I find myself able to embody some of the latest information about the orders for the delivery of tank steamers during the approaching winter.

The shipbuilding developments of the year are evidence that this industry is subject to remarkable fluctuations, not only in the employment of oil-carrying vessels—the sudden change from a period of slackness to one in which it is absolutely impossible to supply the demand—but also in the freight rates, which, in two years, went up something like 200 per cent. Independent owners of oil-carrying shipping found the business unremunerative less than two years ago, while five years ago as many as half a dozen up-to-date tank steamers were moored at the idle buoys at Jarrow Slake on the Tyne. Notwithstanding the partial destruction of the Russian export trade, and the re-employment of Black Sea oil traders in other parts of the world, there was a decided improvement in the chartering twelve months ago, but it was never expected that this would go on as it has done right up to the present time; at any rate, there is no evidence that any of the shipowning concerns made anything like adequate preparations to meet the great demand of to-day. When the 12*s.* freight of 1906 became the 32*s.* freight of 1907, and when, as I have stated elsewhere, three steamers were lost, orders were given for the quickest possible delivery of new tonnage.

The fact then came to light that the first concern to display enterprise in this direction was the Anglo-American Oil Company, which had the great oil-carrier *Iroquois* and a huge oil barge building at Belfast.* A word here about this new steamer. She is 476 ft. long, 60 ft. beam, and has been specially designed and constructed for the transport of about 10,000 tons of oil in bulk. The vessel has an exceptionally complete oil pumping system for loading and discharging, and all the most perfect arrangements for a vessel of this class; indeed, she is the latest word in the specialist business of tank steamer construction. The machinery consists of two sets of quadruple expansion engines, and her four steel boilers are specially arranged for the consumption of oil fuel. She is the first oil tank steamer fitted with twin screws, and has been built, like most of her predecessors in the fleet, under the supervision of Mr. John Morton.

Approximately, the new tonnage (vessels building) amounts to :—

	Tons.
Anglo-American Oil Co.	35,000
Messrs. Lane & Macandrew ...	27,000
Messrs. H. E. Moss & Co.... ...	14,000
Messrs. C. T. Bowring & Co. ...	14,000
Messrs. J. M. Lennard & Son ...	6,000
Messrs. Balfour, Williamson & Co.	7,000
Messrs. Good (Antwerp)	5,000
Two Texas companies (Gulf Refining and Texas)	20,000
	128,000

* Launched by Messrs. Harland & Wolff and christened by Mrs. Powell on June 27th.

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Which at the rate of £11 per ton makes a total in money value of £1,408,000. These new steamers have an increase of 10 per cent. in speed.

Add 10 per cent. for tonnage (chiefly Californian) about which nothing has been made public, and it will be seen that the new tonnage to be placed in the oil trade during the next six months will be worth about £1,500,000.

Messrs. Balfour, Williamson & Co., with Californian oil field and refinery connections, have placed an order for a tank steamer with Messrs. Armstrong, Whitworth & Co. She will carry 7,000 tons, and will be equipped with the latest appliances for the transport and handling of oil in bulk. The engines, of the triple expansion type, will drive her at the rate of 11 knots.

I learn from headquarters that the Texas Company, to which I have made a somewhat lengthy reference in a previous chapter, are building a fifty thousand barrel tank steamer at Newport News, Va. The contract calls for delivery in the spring of 1908, and I understand that she will embody all the latest improvements for the expeditious working and safe transport of petroleum and its products. The company own the following ocean-going steamers and barges:—

	STEAMERS.	
Florida	12,000 barrels	capacity.
Northman	22,000 „	„
Northtown	22,000 „	„
Northwestern	22,000 „	„
	BARGES.	
Dallas	18,000 „	„
Magnolia	7,000 „	„
San Antonio	1,600 tons	„
Morse	1,900 „	„

They also own the ocean-going tug *Brady*, and numerous harbour bulk and deck lighters for the distribution of petroleum products at their Gulf and Atlantic coast terminals. They also operate oil-carrying steamers and barges on the Mississippi River and its tributaries.

It is not only in the building of new tank steamers that the problem of the marine transport of oil is undergoing a change. The progress of shipbuilding science has enabled builders to turn out ships on an increasingly larger scale, and they are only restrained from further increasing the size by the lack of depth in the channels and the length of the dry docks. In point of competition it is known in this business that the large ships can live best at a time of slackness, and that the smallest of them only make profits when freights are good.

For some time it has been felt that means of propulsion less costly than steam is necessary, if coasters are to continue to live and be useful; in fact, coasting ship-owners are eagerly watching the progress of motor propulsion. Crude petroleum, vaporised, has proved economical and effective in the case of pleasure launches as well as canal barges, and no doubt before long it will be applied to coasters. Every mechanical device which reduces the cost of handling makes for economy and efficiency, and the constant endeavours of engineers to cheapen the transporting machines—afloat as well as ashore—are being watched with the keenest interest by traders.

I have made several references to the adoption of the ocean-going barge system by the Standard, Anglo-American and other oil companies. There is evidence of its success in the building of the 10,000 ton barge at Belfast, and one may well ask whether it would not be feasible at this time of high freights to run steam tugs and barges between the oil ports of the Black Sea and the importing centres of the United Kingdom.

* * * * *

Into this part of the book I am able to place the important announcement made by Sir Marcus Samuel, as recently as July 29th, regarding the completion of the transference of the preponderating assets of the Shell Company to the new combination brought into existence by the directors of his company and the Royal Dutch. This is not a work of criticism, and in a history of this kind I am only permitted to reproduce with a very few words of comment what was evidently a most carefully prepared statement.

By the founding of the Anglo-Saxon Petroleum Company, Ltd., which has taken over all the assets of the Shell Company and the Royal Dutch Company properly administerable in England, and of the Bataafsche Petroleum Maatschappij, which becomes the owner of the whole of the properties under the Dutch jurisdiction, the existence of the Shell Transport Company comes to an end, except the part which they play as large shareholders in the other companies, taking their share in the direction, but being in a minority.*

"The occasion is a somewhat painful one to me," said Sir Marcus, "because by the capitulation of our

* Forty per cent. against sixty.

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rights in controlling it, the one territory capable, in my opinion, of providing supplies of liquid fuel sufficient to meet the naval requirements of this country has passed from British hands. We should have been willing to make a very considerable pecuniary sacrifice to have retained these properties had we been able to obtain any assurance from our own Government that we should have had their support in case of any dispute with the Dutch authorities; but not only was such assurance not forthcoming, but, I venture to say, never in the annals of British trade has so gross a wrong been done to any company as that inflicted by the Indian Government, instigated and supported by the Admiralty, in classifying the Shell Company as a foreign corporation, and refusing them permission to participate in the development of the Indian fields. 'Great events from little causes spring,' and I shall be greatly mistaken if, in the future, the folly—nay, I will say the crime—of compelling a British company to part with property of vital import in the future of naval warfare is not bitterly regretted, and for this folly history must fix the blame on the right shoulders; but this I can assure you, that neither your chairman nor directors have been to blame. Under the circumstances, Messrs. M. Samuel & Co. have ceased to be the managers of the Shell Transport and Trading Company, this being one of the provisions made by the Royal Dutch Company; but I hope the shareholders will recognise that it has been under their management that the present sound condition of the company has been reached, and I heartily congratulate you upon being able to state that, in my opinion, a magnificent position has now been attained, since, instead of having practically all our eggs in one basket, we are partners in widespread and well-established productive petroleum fields. Instead of being dependent upon only one refinery, which would have put us in a most serious dilemma in the event of fire, we now have a series of refineries within our working area. The united companies are on absolute rock bottom, being their own producers, and producing oil as cheaply as it can be produced in any part of the world; whilst their geographical position gives them an indisputable command of the area in which they trade. They are their own carriers, passing the oil through their own installations, and distributing it through their own agencies. I cannot imagine any business, therefore, built upon a sounder foundation. This company must be represented on the boards of the Anglo-Saxon Petroleum Company and of the Bataafsche Petroleum Maatschappij, and your directors have come to the conclusion that your interests will be best served by appointing some of their members as delegates to those boards. This will necessarily involve extra payments to the members so employed, who will also conduct such business as remains to the Shell Company, who will now have their separate offices and their own staff. A considerable saving will be made after the present year in the cost of management, since the extensive staff hitherto retained by the managers has been taken over by the combine. Messrs. Deterding and Dr. A. J. Cohen Stuart have been elected to the board of the Shell Company, on the nomination of the Royal Dutch, whilst Mr. Walter H. Samuel has also joined the board, and, to our great regret, Mr. Jardine, who has been associated with the company from its commencement, has retired. The board has been increased in number by these additions to it, and you will be asked to increase their remuneration to £6,000."*

There is no denying the claim of Sir Marcus Samuel that the Shell steamers have rendered valuable service to the British Admiralty. The first supplies of liquid fuel used in British warships were brought here in these steamers, and it will always stand to the credit of Sir Marcus that his enthusiastic and optimistic statements on the advantages of oil fuel did more than anything else to awaken a desire on the part of the Admiralty to formulate a programme of experiments and establish a system of regular supply and permanent storage. Over a period of many years, covering fully half the life-time of the Shell Company, I have contended that the British Government has not been unfavourably disposed towards this particular enterprise, and to those who hold similar opinions the catalogue of the wrongs alleged to have been done by the British Government to Sir Marcus Samuel and his friends must appear to be one of the most amazing ever submitted to a body of shareholders. Oil fields, frequently declared to be a reliable and improving source of oil fuel supply, have passed under the control of a powerful company working under the flag of a comparatively insignificant trading country. The same thing may be said of the Shell steamers, because, obviously, in a time of war they would not be at the disposal of the British Admiralty in the

* Agreed to on the motion of Sir Fortescue Flannery, Bart., at the meeting of the shareholders on July 29th.

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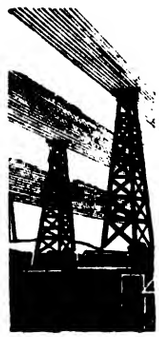
event of their being wanted to bring oil fuel from the Far East.

I, for one, am not satisfied that the question of who is to blame for this is finally settled by the statement of Sir Marcus. There is something behind all this feeling; and, besides, it is just as well to remember that the Admiralty officials are bound by the etiquette and rules of their departments to remain silent, even on such an important subject as the alleged unfair treatment and exile of a company of the standing of the Shell.

No doubt, this loss to the mercantile marine will lead the Admiralty to see how absolutely necessary it is that everything possible should be done to develop the oil fields of the Empire. If the Indian and Colonial oil fields benefit we shall not, from a national point of view, grieve so deeply about the assumption of control of the Borneo fields by the Dutch. This is a subject I have frequently dealt with in other covers.*

* *Petroleum World* for August.



VENTILATING heads or cowls should proceed as direct as possible to weather decks, but should not be too near the smoke stack. Cowls should be fitted with fine wire gauze, soldered into the cowl opening; this permits easy exit of vapour and prevents any back flash in the vapour pipe due to stray sparks from the main funnel or a light on deck. Oil ventilation cowls in their necessarily exposed positions are often caught by the rush of heavy seas, and it is desirable to goose-neck them.

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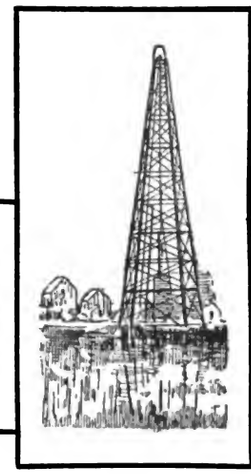
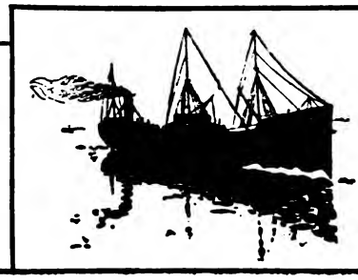


HIGHEST and lowest rates of freight for tank steamers chartered for one voyage to carry refined petroleum from Northern American ports to ports in the United Kingdom or on the Continent (Ostende-Hamburg).

Year.		Highest Rate.	Lowest Rate.		Highest Rate.	Lowest Rate.
1899	Steamers of 5,000 tons and over .	17/-	12/-	Steamers of 3,000 to 4,000 tons .	18/-	13/3 or 13/6
1900	do.	25/-	14/6	do.	25/-	12/6
1901	do.	20/-	14/9	do.	21/-	14/6
1902	do.	12/6	12/-	do.	14/6	12/6
1903	do.	10/6	10/-	do.	12/6	10/6
1904	do.	10/6	10/-	do.	11/6	10/-
1905	do.	11/-	9/9	do.	12/6	10/6
1906	do.	11/3	9/6	do.	12/-	10/6
1907 (up to and including 15th July).	do.	29/-	12/-	do.	30/-	13/6

Early in the year, in consequence of the shortage of tonnage caused by the disasters to tank shipping, and the transference of a number of steamers to the Pacific, rates rapidly increased, and 20/- was paid for the transport of refined petroleum from Northern American ports and the Black Sea to the United Kingdom for July-August loading. It is known that in some cases as much as 30/- and even more was paid. Where 32/- was reached the cargoes consisted of spirit.



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ONE of the largest oil tank storage businesses in the world is controlled by the London and Thames Haven Oil Wharves, Ltd. The directors are Mr. Owen Philipps, M.P. (chairman), Mr. Allen McCall, Mr. F. H. Simmonds, and Mr. Alfred C. Adams. The first chairman was Mr. McCall, and when he resigned in 1901 he was succeeded by Mr. Philipps. The managing-director, Mr. Adams, has held the position since 1898.

The business was originally started in 1876, when the British oil trade was in its infancy and the transportation of oil and spirit in bulk was not thought of. Its rise has been coeval with that of the petroleum trade of this country.

The well-known Thames Haven (Essex) property has many advantages. When it was selected experts considered it to be the most desirable site obtainable for the storage of petroleum spirit. Those who considered the questions of its accessibility and suitability had to take into account the fact that vessels bringing cargoes to the Thames were prevented by the Regulations of the Port from proceeding further up the river than Thames Haven. One advantage it has always had: it occupies an isolated position and has the most up-to-date facilities for rapid communication with the oil-distributing centres.

A deep-water pier, alongside which ocean-going oil-carrying sailing ships of the seventies could moor and discharge, was provided, and in those early days this was the only wharf at which petroleum ships could lie and discharge without the assistance of lighters.

Extensive underground fireproof warehouses, made of concrete, were used for the storage of petroleum spirit and other products of petroleum brought to this country in barrels, and, up to the time of the storage of oil in iron tanks, no better storage accommodation was obtainable anywhere. The warehouses were constructed with solid concrete floors 12 inches thick and party walls 18 inches thick.

The first tanks for the storage of oil in bulk were built in 1885, and from 1887 onwards tanks were added to meet the increasing needs of the industry. The records of the company show that all the pioneer tank steamers discharged at the Thames Haven. In 1898, when the oil trade commenced to rapidly develop, the business of the company became one of considerable importance, and to-day this is the oldest and largest independent oil storage concern in this country.

The company stores petroleum spirit, refined illuminating oils, gas oils, lubricating oils, black oils, fuel oils, fish oils, molasses, etc., and the Thames Haven tanks alone have a capacity of over 100,000 tons. The plant and installation stand on 22 acres of land. Two deep-water piers, with 30 feet of water alongside at low water of spring tides, are capable of accommodating any tank steamer afloat, and vessels lie and discharge direct into the storage tanks ashore. The facilities for the safe and quick handling of spirit cargoes, while both simple and effective, are the result of expert ability and experience. The vessels lie alongside with all fires out, and take their steam from the shore; in other words, the company provides all the steam necessary for the handling of the cargoes, and in this way reduces the risk of accident to a minimum.

With such a large number of liquids to handle simultaneously and separately, the company keeps its up-to-date equipment and organisation in thorough working order, and the risk of accident and contamination is entirely eliminated by a most perfect system of isolation. The fire risk has been carefully studied, and the tanks stand in sections surrounded by chalk embankments. The demands of the Fire Insurance Companies have been met in every particular, and there is an abundant supply of water obtainable at any time from the company's fresh water well.

The pumps which handle the various products are, individually, capable of dealing with quantities up to 300 tons per hour. The works are equipped with electric power and light, and the cranes, also worked by electricity, are capable of handling several thousand barrels of oil a day. Extensive railway sidings are provided for the despatch of oils in tank waggons.

There are three depôts for London delivery. The one at Central Wharf, Bow, London, E., is conveniently and centrally situated to meet the demands of this branch of the business. At this wharf the company possess considerable tankage for the storage of bulk oil. Then there is the Manhattan Wharf (Silvertown), which also has tankage for the storage of petroleum spirit and oil. These two up-town wharves, together with Abbey Mills (a depôt at West Ham, used more particularly for the handling and despatch of motor spirit), form the branches through which the huge quantities of the liquid goods stored at Thames Haven are distributed.

The duties carried on by the company are those of public wharfingers, and merchants who store their goods at these wharves know that the company has absolutely no interest whatever in the purchase or sale of any of the articles for which it provides storage. The record and reputation of the company constitute a valuable guarantee of safe and secret storage of every kind of oil imported into this country by British or foreign companies and merchants.

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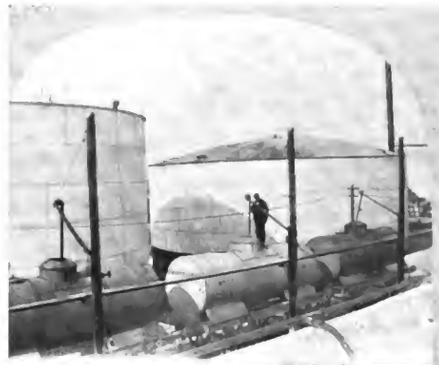
OIL STORAGE AT THAMES HAVEN.

(The property of the London and Thames Haven Oil Wharves, Ltd.)

Cymbeline. *Weehawken.* *Spondilus.*

FILLING TANK CARS.

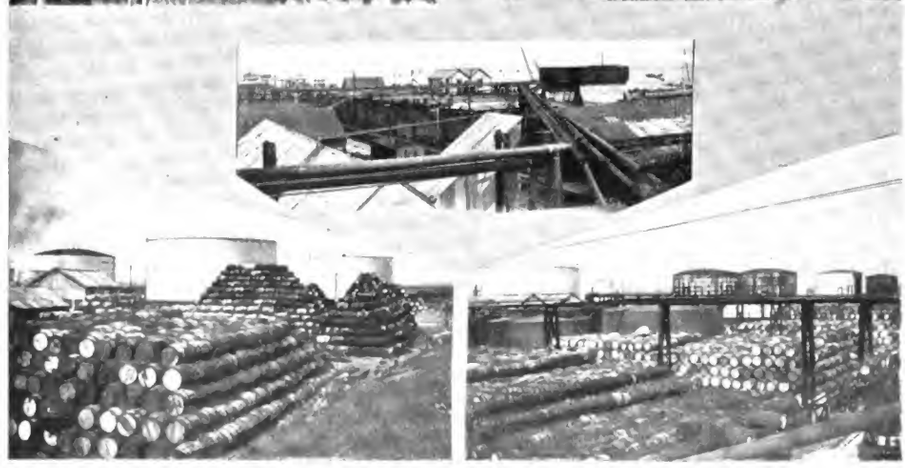


ENTRANCE TO WHARF, SHOWING RAILWAY SIDING.

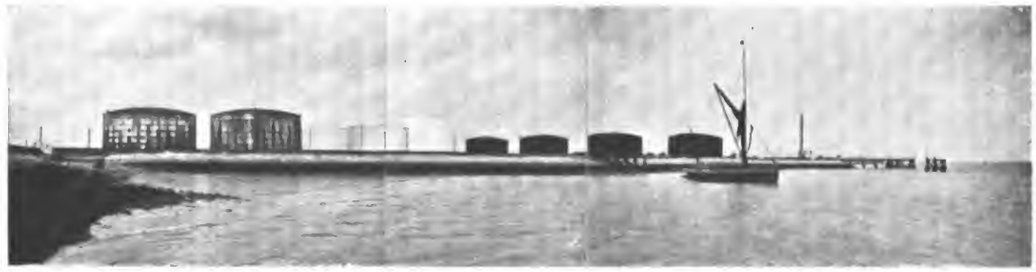
TANKS AND BARRELS.

GENERAL VIEW OF SOME OF THE TANKS.

PIPE LINES LEADING FROM DEEP-WATER PIER NO. I.



GENERAL VIEWS OF EMPTY BARREL STACKING GROUND.



LOWER WHARF, SHOWING DEEP-WATER JETTY (NO. 2) AND TANKS.

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PART III.

TABLES AND FORMULÆ.

Also

RULES AND REGULATIONS FOR THE TRANSPORT OF OIL AND THE NAVIGATION OF TANK STEAMERS IN THE SUEZ CANAL AND RIVERS IN DIFFERENT PARTS OF THE WORLD.

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CHAPTER XVII.

SPECIFIC GRAVITY.

WHENEVER possible, this should be expressed in comparison with water at 60° F., which is taken as 1·000. For example, a crude petroleum would be said to have a gravity of, say, ·800.

In America, Baumé's hydrometer is extensively used, but a comparison between the tables of Baumé degrees given by standard authorities shows such evidences of inaccuracy that it is difficult to understand why this hydrometer is used at all.

For those who have need to use Baumé degrees, however, the following formula for reducing degrees Baumé to specific gravity is perhaps the most accurate. Divide 140 by (°B. + 130).

Example: $\frac{140}{70 + 130} = \frac{140}{200} = ·700$ sp. gr.

To reduce specific gravity to degrees Baumé, divide 140 by the sp. gr., and subtract 130.

Example: $\frac{140}{·700} = 200.$ $200 - 130 = 70°$ B.

In the case of liquids heavier than water, to reduce °B. to sp. gr., divide 140 by (140 − °B).

Example: $\frac{140}{140 - 25} = 1·2175$ sp. gr.

To reduce sp. gr. to °B., subtract $\frac{140}{\text{sp. gr.}}$ from 140.

Example: $140 - \frac{140}{1·2175} = 140 - 115 = 25°$B.

To reduce degrees Twaddell to sp. gr., multiply by 5, add 1000 and divide by 1000.

Example: 15° T. × 5 + 1000 = 1075.

1075 ÷ 1000 = 1·075 sp. gr.

To reduce sp. gr. to °T., multiply by 1000, subtract 1000 and divide by 5.

Example: 1·075 × 1000 = 1075 − 1000 = 75.

$\frac{75}{5} = 15°$ T.

TEMPERATURE.

Formula for converting degrees Fahrenheit (°F.) into degrees Centigrade (°C.):—

Subtract 32, multiply by 5 and divide by 9.

Example: To convert 140° F. into °C.:—

$140 - 32 = 108.$ $\frac{108 \times 5}{9} = 60°$ C.

Formula for converting degrees Centigrade into degrees Fahrenheit:—

Multiply by 9, divide by 5, and add 32.

Example: To convert 84° C. into °F:—

$\frac{84 \times 9}{5} = 121·2 + 32 = 153·2$ °F.

Formula for converting degrees Fahrenheit into degrees Réaumur (°R.):—

Subtract 32, multiply by 4 and divide by 9.

Example: To convert 140° F. into °R.:—

$140 - 32 = 108.$ $\frac{108 \times 4}{9} = 48°$ R.

Formula for converting degrees Réaumur into degrees Fahrenheit:—

Multiply by 9, divide by 4 and add 32.

Example: To convert 48° R. into °F.:—

$\frac{48 \times 9}{4} + 32 = 140°$ F.

STEAM.

In the conversion of water into steam, the temperature must first be raised to boiling, before the actual evaporation takes place. When the water is boiling the temperature remains constant, the heat which is applied disappearing in the formation of steam.

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The amount of heat which disappears during the evaporation of 1 lb. of water at 212° F. (boiling), is 966 British Thermal Units, or heat units. This is known as the latent heat of steam.

To calculate the number of heat units required to evaporate water at any temperature to steam, at ordinary atmospheric pressure, subtract the temperature of the water in degrees F. from 1178.

Example: To convert 1 lb. water at 140° F. into steam :—

1178 − 140 = 1038 (B.T.U. required).

To calculate the number of heat units required to evaporate water at any temperature at pressures greater than the normal atmospheric pressure, add ·305 times the temperature in degrees F. to 1082.

Example: To evaporate 1 lb. water at 298° F. (50 lbs. pressure) :—

·305 × 298 = 90·89. 1082 + 90·89 = 1172·89 B.T.U.

Table showing temperature and latent heat of steam at temperatures above that of the atmosphere :—

Pressure (lbs. per sq. in.).	Temperature, °F.	Latent Heat, B.T.U.	Pressure (lbs. per sq. in.).	Temperature, F°.	Latent Heat, B.T.U.
0	212	966	100	338	876
5	227	955	105	341	874
10	239	947	110	344	872
15	250	939	115	347	870
20	259	933	120	350	868
25	267	927	125	353	866
30	274	922	130	356	864
35	281	918	135	358	862
40	286	913	140	361	860
45	292	909	145	363	858
50	298	905	150	366	856
55	303	902	155	368	854
60	307	898	160	371	853
65	312	895	165	373	851
70	316	892	170	375	849
75	320	890	175	377	848
80	324	887	180	379	846
85	327	885	185	382	845
90	331	882	190	384	843
95	334	879	200	388	840

To calculate temperatures beyond the range of a thermometer (approximately) :—

Insert a bar of iron in, for example, the chimney of a steam boiler, heat it to the maximum degree, quench it in cold water and measure the rise in temperature of the water.

T = temperature of water after quenching.
t = original temperature of water.
W = weight of cold water.
w = weight of iron in pounds.
X = temperature of the steam.

$$X = \left\{\frac{(T-t) \times W \times 9}{w}\right\} + T$$

Example: A bar of wrought iron, 20 lbs. in weight is inserted in the chimney of a boiler, and when heated, quenched in 30 lbs. of water at 55° F., raising the temperature of the water to 93° F.

$$\frac{(93^\circ - 55^\circ) \times 30 \text{ lbs. water} \times 9}{20 \text{ lbs. iron.}} = 513^\circ \text{ F.}$$

513° F. + 93° F. = 606° F. temperature of the gases in the chimney of the boiler.

WATER.

To calculate the capacity of cylindrical vessels, multiply the square of the diameter in feet by ·7854, and the product by the length in feet. The result is the capacity in cubic feet, which, multiplied by 6·23, equals the capacity in gallons.

Example: Find the capacity of a cylinder, 6 ft. in diameter and 20 ft. in length.

6 × 6 × ·7854 × 20 = 565·528 cubic ft. or 3523·24 gallons.

Formula for calculating the rate of discharge of water by gravity from a tank :—

$$Q = \cdot 82\, A \sqrt{2gh}.$$

Q = cubic feet per second.
A = area of pipe in sq. ft.
h = distance in feet from the bottom of the pipe to the surface of the water in the tank.
g = gravity (32 ft. per second).

Example: Find the rate of discharge of water through a 3 in. pipe (area ·049 sq. ft.), 10 ft. long, with 5 ft. of water in the tank.

$\cdot 82 \times \cdot 049 \sqrt{2\,(32 \times 15)} = \cdot 04018 \times 30\cdot 98 =$ 1·244 cubic ft. per second, or 7·75 gallons.

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The maximum flow of water through short lengths of piping, for cooling tanks, condensers, etc., is as follows:—

Diam. of pipe in inches.	Gallons per hour.	Diam. of pipe in inches.	Gallons per hour.
1	192	4	6144
1½	528	5	10733
2	1086	6	16931
2½	1896	7	24890
3	2993	8	34765

PIPES.

Formula for calculating the weight of pipes:—

$$W = K (D^2 - d^2).$$

W = weight per lineal foot of pipe.
D = external diameter.
d = internal diameter.
K = co-efficient.

Co-efficient for various metals:—

Iron, 2·64; Cast-iron 2·45.
Copper, 3·03.
Brass, 2·82.

Example: What is the weight of 30 ft. of copper piping, 2½ in. external diameter, with walls ⅛ in. thick?

$$W = 3{\cdot}03 (2{\cdot}5^2 - 2{\cdot}25^2).$$
$$3{\cdot}03 (6{\cdot}25 - 5{\cdot}06).$$
$$3{\cdot}03 \times 1{\cdot}19 = 3{\cdot}6057.$$
$$30 \times 3{\cdot}6057 = 108{\cdot}17 \text{ lbs.}$$

Weight of piping, in pounds per lineal foot:—

Diameter in inches.	Cast Iron.		Wrought Iron.	Brass.	Copper.	
	⅛ in. thick.	¼ in. thick.	(Steam.)	(Ordinary.)	1/16	⅛
½	—	—	1·00	0·25	0·42	0·94
¾	—	—	1·40	0·43	0·62	1·33
1	4·66	7·35	2·03	0·59	0·79	1·69
1½	7·36	13·91	3·81	1·00	1·15	2·44
2	8·70	16·10	4·48	1·25	1·55	3·21
2½	—	—	—	1·50	1·94	3·97
3	12·40	22·1	7·56	1·87	2·30	4·73
4	16·10	28·3	9·85	—	3·00	6·06
5	19·80	34·4	14·44	—	3·81	7·75
6	23·40	40·6	17·32	—	4·54	9·09

A rough rule for finding the weight of oil contained in a length of piping is the following:—Square the diameter in inches, and the result will be pounds per yard.

WEIGHTS AND MEASURES USED IN FOREIGN COUNTRIES.

METRIC SYSTEM.

1 mètre = 1 yard, 3·37 inches.

1 kilomètre = 1,093 yards, 1 foot, 10·79 inches.

1 are = 100 square mètres, or 119·6033 square yards.

1 litre = 1,000 cubic centimètres, or 1·76077 pints.

1 kilogramme = 2 lbs. 3 ozs. 4·38 drams.

RUSSIA.

Russian lb. = ·9028 English lb. = ·4095 kg.

English lb. = 1·1076 Russian lbs. = ·4536 kg.

One kilogram = 2·2046 English lbs. = 2·4419 Russian lbs.

One pood (40 Russian lbs.) = 36·114 English lbs. = 16·38 kg.

Cwt. (112 lbs.) = 124·0512 Russian lbs. = 50·8032 kg.

Metric centner (100 kg.) = 220·46 lbs. = 244·19 Russian lbs.

English ton (2,240 lbs.) = 62·0280 poods = 1·06 metric ton.

Metric ton (1,000 kg.) = ·9842 English ton = 61·048 poods.

Measures of Length.

Russian duim = English inch.

Vershock = 1¾ duims.

Foot (12 duims) = 1 English foot = ·3047944 1616 metre.

Arshin (3 feet) = ·7 Eng. yard = ·71118696104 metre.

English yard = 1·285714 arshin = ·914391428 metre.

Metre = 3·2808992 feet = 1·09362355 yard = 22·49759792 vershocks.

Sazhen (7 feet) = 2·133291 metres.

Verst (500 sazhens) = ·66269 English mile = 1·06678 kilomètres.

English mile (5280 feet) = 1·50857 versts = 1·6093 kilomètres.

Kilomètre = ·9374 verst = ·6211 English mile.

Russian mile (7 versts) = 4·63883 English miles = 7·48746 kilomètres.

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Measures of Area.

Dessiatin (60 by 40 sazhens) = 117,600 square feet = 2·6997 acres = 1·0925 hectares.

Acre = ·3704 dessiatin = ·442244 hectare.

Hectare = ·9153 dessiatin = 2·2612 acres.

Measures of Capacity (for Liquids).

Vedro = 2·70698 English gallons = 3·249 American gallons = 12·299 litres (12299 c.c.).

English gallon = ·3694 vedro = 1·196536 American gallons = 4·5435 litres.

Litre = ·081308 vedro = ·228 English gallon = ·264 American gallon.

American gallon = ·3078 vedro = ·8332 English gallon = 3·785 litres.

Equivalent Weights and Measures of Caucasian and American Oils.

Caucasian crude of ·878 sp. gr.

Vedro = 26·34 Russian lbs.

Imperial gallon = 9·7 Russian lbs.

Litre = 2·144 Russian lbs.

American gallon = 8·1 Russian lbs.

A pood occupies 1139 cubic inches = 4·123 Imperial gallons = 18·656 litres = 4·939 American gallons.

Caucasian Export Kerosene of ·825 sp. gr.

Vedro = 24·75 Russian lbs.

Imperial gallon = 9·139 Russian lbs.

Litre = 2·015 Russian lbs.

American gallon = 7·617 Russian lbs.

Pood = 4·377 imperial gallons = 19·9 litres = 5·249 American gallons.

English ton = 271·49 English gallons.

(American kerosene of equal volume only weighs 96·6 per cent. of Russian export kerosene, *i.e.*, the American is 3·4 per cent. lighter than the Russian.)

AMERICA (UNITED STATES).

The English system is used in the United States, with the exception that a small ton of 2,000 lbs. is generally used and the United States gallon = 0·833 Imperial gallon.

GERMANY.

1 Meil = 4·68 English miles.

1 Geo. square mile = 21·195 square miles.

1 Centner = 110¼ lbs. avoir.

DENMARK.

1 Geo. square mile = 21·195 square miles.

1 Tönde (coal) = 4·6775 bushels.

1 Pfund = 1·1023 lbs. avoir.

AUSTRIA.

1 square mile = 22·1 square miles.

1 Centner = 110¼ lbs. avoir.

1 Cubic Fuss = 1·156 cubic feet.

GREECE.

Ocque = 2·84 lbs. avoir.

Quintal = 110·2 lbs.

NORWAY.

Centner = 109·87 lbs. avoir.

Tönde (coal) = 3·8 Imp. bushels.

Pott = ·2124 gallon.

Commercial last = 179·85 cubic feet.

SWEDEN.

Skälpund = ·937 lbs. avoir.

Centner = 93·7 lbs. avoir.

Kan = ·576 Imp. gallon.

COINAGE USED IN FOREIGN COUNTRIES.

RUSSIA.

	s.	d.
Copeck (Copper)	0	0½
Rouble (Silver) (100 copecks) ...	2	1½
5 Roubles (Gold)	10	8
7½ „ „	16	0

AMERICA (UNITED STATES).

	s.	d.
Cent (Copper)	0	0½
Dime (Silver)	0	5
Dollar (Silver or Gold)	4	2

GERMANY.

	s.	d.
10 Pfennig	0	1¼
Mark	1	0
Thaler (3 marks)	3	0

DENMARK.

	s.	d.
10 Ore	0	1¼
Kroner (Silver)...	1	1½
10 Kroner (Gold)	11	1½

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AUSTRIA.

	s.	d.
10 Heller	0	1
Krone (Silver)	0	10

NORWAY AND SWEDEN.

	s.	d.
10 Ore	0	1¼
50 „ (Silver)...	0	6¾
1 Kroner „	1	1½
10 Kroner (Gold)	11	1½

BARRELS.

Size of Barrels.—An ordinary barrel is 33 ins. long, and 25 ins. in diameter at the shivehole. When full, its weight is roughly 400 lbs., the barrel itself weighing about 64 lbs., or roughly one-fifth of the weight of the oil it contains. According to the rules of the New York Produce Exchange, petroleum barrels should be made of well seasoned white oak, and bound by 6 or 8 hoops. When 6 hoops are used, the head hoop should be 1¾ in. wide No. 16 gauge (English), the quarter hoop 1½ in. wide No. 16 gauge, and the bilge hoop 1¾ in. No. 16 gauge. When 8 hoops are used, the head hoop should be 1¾ in. No. 17 gauge, the collar hoop 1¼ in. No. 17 gauge, the quarter hoop 1½ in. No. 18 gauge, and the bilge hoop 1½ in. No. 18 gauge. All old barrels, the gross weight of which is less than 395 lbs., may be hooped with 6 hoops 1½in. wide, excepting the chime hoop, which should be 1¾ in. wide. Barrels are classified according to the use to which they are put. First class—all barrels capable of carrying refined petroleum or naphtha. Second class—those which are not fit for such purpose, but are suitable for carrying crude petroleum; and, third class—those suitable for holding residuum.

Kerosene is frequently carried in tins, holding about 4 Imperial or 5 American gallons. Two of these tins are contained in a wooden case of the following dimensions—20¾ ins. long, 15 ins. high and 10½ ins. wide, externally. The total weight, when both cans are filled with oil, is about 80 lbs. For transport the cans are hermetically sealed and are provided with screw caps for subsequent use.

HYDRAULICS.

One cubic foot of fresh water weighs 62·32 lbs. and contains 6.23 gallons.

One cubic inch of fresh water weighs ·03616 lb. and contains ·003616 gallon.

One ton of fresh water = 35·905 cubic ft., or 223·76 gallons.

One gallon of fresh water weighs 10·0 lbs.

One cylindrical inch of water = ·0284 lb.

One cylindrical foot of water = 48·96 lbs.

A column of water 12 ins. long, and 1 in. square = ·340 lb.

Pumps.

Useful numbers for pumps:—

D = Diameter of pump in inches.
S = Stroke in inches.
$D^2S \times ·7854$ = cubic inches.
$D^2S \times ·002833$ = gallons.
$D^2S \times ·02833$ = lbs. water.
$D^2S \times ·0004545$ = cubic feet.

To find the net diameter of a single-acting pump:—

L = length of stroke in feet.
G = number of gallons to be delivered per minute.
F = number of cubic feet to be delivered per minute.
D = diameter of pump in inches.
N = number of strokes per minute.

$$F = ·00545\, D^2\, L\, N$$
$$G = ·034\, D^2\, L\, N$$
$$D = \sqrt{\frac{g}{·034\, L\, N}}$$
$$D = \sqrt{\frac{F}{·00545\, L\, N}}$$

(MOLESWORTH).

The use of oil in stormy weather is a recognised subject in standard books on seamanship, and one of exceptional interest to those who are responsible for the navigation of oil-carrying vessels. At a recent Board of Trade inquiry it was shown that the Harwich steamer *Berlin* might have been saved if, just before she struck the pier head at the Hook of Holland, oil had been freely released forward. The International Marine Conference at Washington has recommended Governments to require sea-going vessels to carry suitable apparatus and sufficient quantities of oil for this purpose, and I am aware that on the *Narragansett* and a number of tank steamers there are arrangements for the proper use of oil in cases of emergency.

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Thick and heavy oils are best. Cocoanut and some kinds of fish oil congeal in cold weather and are useless, but may be mixed with mineral oils to advantage. Probably the best temporary or improvised method is to fill the closet bowls forward with oakum and oil, and allow the oil to drip slowly through the waste pipes. Another simple way to distribute oil is by means of canvas bags, 1 ft. long, filled with oakum and oil, pierced with holes and held by a lanyard. Running before a gale, oil should be used from bags at the catheads or from forward waste pipes; if yawing badly, and threatening to broach-to, use forward and abaft the beam, on both sides, while, when lying-to, distribute from the weather bow. With a high beam sea use bags at regular intervals along the weather side. In a heavy cross sea have bags along both sides. When steaming into a heavy head sea use oil through forward pipes. Oil can be advantageously used when lowering and hoisting boats, riding to a sea anchor, crossing rollers or surf on a bar, and from lifeboats and stranded vessels.

. . . SCHUYLKILL, where the oil floats down from Point Breeze to the Delaware, just where the city of Philadelphia disperses itself into straggling suburbs. Here are the great refineries of the Standard Oil Company, overhanging wharves where the big ships of all the world lie up to take in case oil, generally for Japan and the other markets of the Far East. The tank steamers, with their funnels and deck-houses crowded aft over their rumps, throng the stream, and often one may see huge sailing ships filling up . . . .

PERCEVAL GIBBON.

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CHAPTER XVIII.

THE PETROLEUM ACT, 1871.

SECTION 4 of this Act provides as follows:—

"Where any ship or cargo is moored, landed, or otherwise dealt with in contravention of any byelaw for the time being in force under this Act in any harbour, the owner and master of such ship or the owner of such cargo, as the case may be, shall each incur a penalty not exceeding fifty pounds for each day during which such contravention continues, and it shall be lawful for the Harbour Master, or any other person acting under the orders of the Harbour Authority of such harbour, to cause such ship or cargo to be removed at the expense of the owner thereof, to such place as may be in conformity with the said byelaw, and all expenses incurred in such removal may be recovered in the same manner in which penalties are by this Act made recoverable."

THAMES CONSERVANCY BYELAWS.

(UNDER THE PETROLEUM ACTS, 1871 AND 1879.)

The Conservators of the River Thames direct as follows:—

No petroleum ship entering the Thames shall be navigated, lie in, or be moored, and no part of the cargo of such petroleum ship shall be discharged, in any part of the Thames above or to the westward of the Mucking Light at Thames Haven.*

All petroleum ships and barges shall, when moored or anchored, lie singly, and there shall be a clear space of not less than 100 ft. of water-way kept between any such petroleum ships or petroleum barges. Provided that this byelaw shall not apply in the case of a petroleum barge lying alongside a petroleum ship for the purpose of being laden or discharged, nor to petroleum barges when lying alongside a quay and actually discharging, nor to a tug and petroleum barges moored or anchored on account of fog or other exceptional cases.

The master of every petroleum ship shall, on entering the Thames, and during the time that such ship remains in the Thames, display at the masthead by day a red flag not less than 3 sq. ft., with a white circular centre 6 in. in diameter, and by night a red light on the masthead in addition to any navigation lights which may be required by any other byelaws or rules.

Whenever a petroleum ship enters the Thames the owner shall forthwith give notice to the Harbour Master at his office at Gravesend of the quantity of petroleum in such ship and of the manner in which such petroleum is stowed. Such notice shall be deemed to be the notice to the Conservators required by Section 5 of the Petroleum Act, 1871.

The master of every petroleum ship shall anchor or moor his ship below or to the eastward of the Mucking Light at Thames Haven, and in such position as the Harbour Master shall from time to time direct, and shall not remove therefrom except in accordance with the written order or permission first obtained of the Harbour Master, or for the purpose of forthwith leaving the Thames. No petroleum ship shall be discharged except at a place previously approved in writing by the Harbour Master.

The following rules in respect of the discharge of petroleum within the Thames shall be in every case complied with:—

(*a*) Before any petroleum is discharged the owner shall give notice to the Harbour Master of the district in which such discharge is to take place of the time and place of such discharge, and no petroleum shall be discharged during any day unless such notice shall have been given before the hour of ten in the forenoon of that day. (*b*) No petroleum shall be landed at any quay other than such quay as the Harbour Master shall from time to time direct. (*c*) Before any petroleum in barrels, drums, or other vessels is discharged from a petroleum ship, the holds of such petroleum ship shall be thoroughly ventilated, and after all petroleum has been removed from any

* A movement has just been started to secure the abrogation of this byelaw in order that tank steamers may be towed to, and discharge at, storage installations higher up river.

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petroleum ship the holds and tanks shall be thoroughly cleansed. Provided that this byelaw shall not be deemed to require the cleansing of the tanks of a tank steamer which leaves the Thames immediately after the discharge of the cargo of petroleum, and of which the tanks are closed up immediately after such discharge. (*d*) From the time when the holds or tanks of a petroleum ship are first opened for the purpose of discharging petroleum until such time as all petroleum shall have been discharged from such ship and the holds or tanks shall have been thoroughly cleansed, as required by this byelaw, there shall be no fire or artificial light on board such ship. Provided that this byelaw shall not prevent the use of a safety lamp of a construction previously approved by the Harbour Master. (*e*) No person shall smoke, nor shall the master permit any person to smoke upon any petroleum ship when its cargo is being discharged, nor shall any person engaged in the discharge of any petroleum ship carry matches or other means of producing ignition. (*f*) When the discharge of petroleum has been commenced such discharge shall be proceeded with with all due speed and diligence, and should it be impracticable to complete the discharge of any petroleum ship or petroleum barge before sunset on any one day, all tanks and holds shall be securely fastened immediately such discharge is discontinued, and all the same precautions taken as though bulk had not been broken. Provided that tank steamers which shall have commenced discharge before sunset shall be permitted to continue such discharge into reservoirs on shore or into tank barges. (*g*) Petroleum shall not be discharged in the Thames after sunset or before sunrise except as provided in sub-section (*f*). (*h*) Petroleum contained in barrels, drums, or other vessels which are not staunch and free from leakage shall only be discharged on shore at a duly licensed wharf, and not into a petroleum barge or any other vessel. (*i*) No petroleum shall be landed at any quay until the petroleum ship or petroleum barge, or carriage by which the same is to be removed therefrom, shall be at the place in readiness to receive the same, and all petroleum discharged in the Thames shall be forthwith removed therefrom, or to some duly licensed place of storage. (*j*) No petroleum shall be discharged or allowed to escape into the Thames. (*k*) The owner shall take all due precautions for the prevention of accident by fire in the discharge of petroleum in the Thames.

No imported petroleum shall be conveyed up the Thames above or to the westward of the Mucking Light at Thames Haven except in a petroleum barge, and no petroleum shall be conveyed in any barge on the Thames other than a petroleum barge.

No petroleum ship shall be navigated on or lie in the Thames except the same be constantly in charge of a competent person on board such ship until all petroleum on board shall have been discharged, and the master of every petroleum ship shall at all times be responsible for the carrying out of and giving effect to the provisions of these byelaws.

The master shall, when so required by the Harbour Master or by any police constable, show to such Harbour Master or constable all petroleum under his control upon the petroleum ship or petroleum barge, and shall afford every reasonable facility to enable such Harbour Master or constable to inspect and examine such petroleum and such petroleum ship and petroleum barge, so that he may ascertain whether the provisions of these byelaws are duly observed.

When any petroleum ship, petroleum barge, or cargo is moored, discharged, or landed or otherwise dealt with in contravention of any of the above byelaws, the owner and master of such petroleum ship or petroleum barge, and the owner of such cargo, shall each incur a penalty not exceeding £50 for each day during which such contravention continues, and it shall be lawful for the Harbour Master to cause such petroleum ship, petroleum barge, or cargo to be removed at the expense of the owner thereof to some place at or below the Mucking Light at Thames Haven, and all expenses in or incident to such removal may be recovered in the same manner in which penalties are by "The Petroleum Act, 1871," made recoverable.

MERSEY DOCKS AND HARBOUR BOARD.

Vessels containing petroleum of any kind as cargo are prohibited from entering any other docks than those adjoining the quays where the landing of petroleum is permitted under the byelaws, and the limits of mooring in the River Mersey, for vessels carrying over 200 gallons of "dangerous petroleum," are fixed as northward of a line from Victoria Tower to Egremont Ferry, or south of a line between New Ferry Pier and Dingle Point.

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The landing of "dangerous petroleum"* must be effected between 6 a.m. and 6 p.m. from March to September inclusive, and between 8 a.m. and 4 p.m. from October to February. No fires, lights, or matches, other than safety-matches, may be used either on such vessels or on the quays where the oil is being landed or stored, and both ships and quays must be under the supervision of a competent watchman. The same regulations apply also to the loading of vessels with "dangerous petroleum." During the loading of vessels containing over 200 gallons of such oil, and their stay in dock—which, however, must in no case exceed twenty-four hours—a police constable must be present. Steamers about to leave dock are allowed to use such fires and lights as may be necessary for four hours after leaving. All casks containing "dangerous petroleum" brought to, or placed on, any quay for shipment, must be distinctly marked as dangerous.

HULL.

(BYELAWS, MAY IST, 1902, WHICH APPLY TO ALL PARTS OF THE HARBOUR KNOWN AS THE OLD HARBOUR AT KINGSTON-UPON-HULL.)

The owner of every petroleum ship on entering the Old Harbour shall, without delay, inform the Harbour Master and Petroleum Inspector of the quantity of petroleum on his ship and of the manner in which such petroleum is stowed, and this shall be deemed to be the notice to the Harbour Authority required by Section 5 of the Petroleum Act, 1871.

The master of every petroleum ship (except the river craft) shall (unless the ship shall proceed direct on the same tide to a destination above the Old Harbour) place or moor his ship only at the wharf situated on the west side of the Old Harbour, and known as Sand South End Wharf, and shall not, without the written order or permission of the Harbour Master, remove his ship therefrom, except for the purpose of proceeding direct into the Humber. Any such ship, if bound to any place above the Old Harbour, shall, after the giving of such notice as aforesaid, proceed to her destination without delay. No petroleum ship shall be anchored or moored at any place other than the said Sand South End Wharf, whether for the purpose of landing or shipping petroleum or otherwise, except river craft having on board as cargo not more than five tons of petroleum consigned from any dock at Hull to some other port or place on the Humber, Ouse or Trent, or on a navigation connected therewith, which river craft, if waiting for the tide or to be towed to their destination, may be anchored or moored at such place and for such period as the Harbour Master shall, after receiving such notice as aforesaid, direct, provided that the above-mentioned limit of five tons shall include all petroleum (whether within the meaning of the Petroleum Act, 1879, or not), which may also be on board the ship.

The following general rules in respect of the unloading of petroleum within the Old Harbour shall be duly observed:—(*a*) Before any petroleum is landed the owner shall give due notice to the Harbour Master and the Petroleum Inspector of the time and place of such landing. (*b*) No petroleum shall be landed at any quay other than the said Sand South End Wharf. (*c*) Before any petroleum contained in barrels, or other vessels, is landed, the holds of a petroleum ship shall be thoroughly ventilated, and after all petroleum has been removed from any petroleum ship, the holds and tanks shall be thoroughly cleansed. Provided that this byelaw shall not be deemed to require the cleansing of the tanks of a tank steamer which leaves the Old Harbour immediately after the discharge of the cargo, and of which the tanks are closed up immediately after such discharge. (*d*) Petroleum shall not be landed except between the hours of sunrise and sunset. (*e*) From the time when the holds or tanks of a petroleum ship are first opened for the purpose of landing petroleum until such time as all petroleum shall have been removed from such ship, and the holds or tanks shall have been thoroughly cleansed as required by this byelaw, there shall be no fire or artificial light on board such ship or at or near the place where the petroleum is being landed. Provided that this byelaw shall not prevent the use of a safety lamp of a construction approved by the Petroleum Inspector. (*f*) The owner shall not allow any smoking at or near the place where petroleum is being landed, nor shall he allow any person engaged in such landing to carry fuzees, matches, or other appliances whatsoever for producing ignition. (*g*) No petroleum contained in casks, barrels, or other vessels, shall be landed in the Old Harbour, unless such vessels are staunch and free from leakage, and are of such

* "Dangerous petroleum" includes all such petroleum and all such oil derived from petroleum, coal, schist, shale, peat, or other bituminous substance, and any product of petroleum, or any of the oils above-mentioned that gives off an inflammable vapour at a temperature of less than 100° of Fahrenheit's thermometer, when tested in the manner set forth in the schedule to "The Petroleum Act, 1871."

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strength and construction as not to be liable to be broken or to leak, except in case of gross carelessness or extraordinary accident. (*h*) When the landing of petroleum has been commenced, such landing shall be proceeded with with due diligence. (*i*) No petroleum shall be landed at any quay until the ship or carriage by which the same is to be removed therefrom shall be at the place in readiness to receive the same, and all petroleum landed in the Old Harbour shall be forthwith removed therefrom, or to some duly licensed place of storage. (*j*) No petroleum shall be discharged or allowed to escape into the waters of the Old Harbour. (*k*) The owner shall take all due precautions for the prevention of accident by fire in landing petroleum.

Two or more petroleum ships shall not, except for purpose of transhipment, lie within 100 ft. of one another, unless, in the opinion of the Harbour Master, it is impracticable to maintain such distance.

Every petroleum ship shall be watched by a competent person on board such ship until all petroleum on board shall have been landed, or until such ship shall have left the Old Harbour, and every petroleum ship shall at all times have on board a responsible person to carry out and give effect to the provisions of these byelaws.

The owner shall, when so required by the Harbour Master, or by the Petroleum Inspector of the Local Authority, or by any police constable, show to such officers or constable all petroleum under his control or upon his ship, and shall afford every reasonable facility to enable such officers or constable to inspect and examine such petroleum so as to ascertain whether these byelaws are duly observed.

These byelaws do not apply to any ship employed by any Lighthouse Authority.

BRISTOL DOCKS COMMITTEE.

Previous to the discharge of any petroleum, a certificate must be produced by the importer stating that the oil does not flash under 73° F., and, if possible, also stating the temperature at which it does flash.

An application in writing must be made by the importer to the Harbour Master for permission to pump the oil from the vessel into the pipes leading to the storage tanks, or into tanks placed on the quay, and the applicant must indemnify the Corporation of Bristol against all losses, damages, costs, or expenses which they may incur or become liable for by reason of the granting of any such permission. No oil shall be allowed under any circumstances to leak or flow into the dock, or on to the quay.

No fires or lights shall be allowed on board the vessel during the time of discharging, except such necessary fires in the engine-room for generating steam for pumping the oil as the Harbour Master may from time to time permit; and no smoking shall be allowed on board the vessel, or any lying alongside, or on the quay during such time.

Every possible precaution must be taken, both by the master of the vessel and by the importer, to prevent risk of fire or explosion; and also to prevent any oil being spilled on the quay, or leaking or flowing into the dock. Notice in writing must be given by the master of the vessel to the Harbour Master previous to water being pumped into the tanks of the vessel.

The vessel shall not, whilst in the dock, be left without a sufficient crew on board. No persons, other than the crew and such other persons as shall be employed or engaged by the importer, or by the master or owner of the vessel in connection with the discharge of the cargo, shall be allowed on board the vessel or on the quay alongside.

For the safer discharge of the cargo, an officer will be sent by the Harbour Master to superintend the carrying into effect of these regulations, payment being made of the expense of such superintendence by the master or owner of the vessel; and the payment of such expense of superintendence shall continue until the production to the Harbour Master of a certificate under the hand of such officer that the cargo has been duly discharged.

An application in writing must be made to the Harbour Master for permission to ventilate the tanks after the oil has been pumped therefrom, an intimation being given at the same time as to the mode in which it is proposed to effect such ventilation; and the Harbour Master may, in his discretion, either withhold or grant such permission, and subject to such special regulations and arrangements as he may deem necessary.

No lighter or other craft shall, except with the permission of the Harbour Master, lie alongside any vessel during the discharge of her cargo.

Every vessel having petroleum on board shall keep conspicuously exhibited from sunrise to sunset a red flag.

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Steamers of the . . Royal Dutch Company.

THE Kon. Nederl. Maats. tot Exploitatie van Petro. Bronnen in Nederl. Indie (Royal Dutch) has now a great interest for British oil men and the shareholders of the Shell Transport & Trading Company. Before the amalgamation with the Shell Company, the Royal Dutch had a fleet of medium-sized tank steamers running in the Far East; they are now being run in conjunction with some of the Shell steamers.

One of the latest of the Royal Dutch vessels is shown in the photograph—the *Palembang*, built and engined by the Nederl. Schps. Maats., Amsterdam, in 1905. Her dimensions are: 240 ft. × 42 ft. × 20 ft. A complete double pipe installation, fitted with two powerful oil pumps, is capable of dealing simultaneously with two kinds of oil. She is one of the latest and best of her class in the Far East.

THE PALEMBANG.

[*To face p. 100.*

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UNIV. OF MICH.

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SUEZ CANAL (WORKING DEPARTMENT) REGULATIONS FOR NAVIGATION.

(Appendix for Ships laden with Petroleum Oil in Bulk. Issued January, 1907.)

Any ship laden with petroleum in bulk, arriving before any port of access to the canal, must make herself known by flying at the mizzen one of the following signals:—

By day: A red flag above one ball.

By night: A white light beneath two red ones.

When the ship goes through the canal she must keep the above signals flying during the whole of her transit.

Before the ship enters the canal the captain must sign and hand to the officials of the company the following declaration.

Declaration.—I, the undersigned, commanding the ship laden with petroleum oil in bulk and belong to owners, do hereby declare, on behalf of the said owners, as follows:

1. This ship is especially classed for the carriage of petroleum oil in bulk in class (1).

✠ 100 A1 at Lloyd's in London;

✠ ⊙ 3/3 I. I. in the Bureau Veritas;

✠ 100 Ⱥ in the Germanic Lloyd (Berlin).

2. No single tank in the ship has a cubic capacity greater than 500 tons measurement (being tons of 2·83 cubic metres, or 100 cubic ft. English), nor can discharge its contents into any adjoining tank through any aperture or want of continuity whatever of its walls.

3. The petroleum contained in her tanks is solely refined petroleum of an uniform quality, no sample of which taken at the port of loading shall have given a flashing point below 23° C. (73 degrees of Fahrenheit's thermometer), this temperature having been ascertained conformably with such process of close test as may be recognised and made use of in the petroleum oil trade, as, for instance, the Abel test or any other close test of a not lesser degree of accuracy.

4. No part of the ship, other than her tanks, contains any products, whether petroleum, or by-products of petroleum, such as gasoline, benzine, etc., having a flash point below 66° C. (150° F.), tested as prescribed in paragraph 3.

Rules for Burning and Carrying Liquid Fuel.

The following rules for steel vessels have been approved by Lloyd's:—

1. In vessels fitted for burning liquid fuel, the record "Fitted for Liquid Fuel" will be made in the register book.

2. Compartments for carrying oil fuel must be strengthened efficiently to withstand the pressure of the oil when only partly filled and in a sea-way. They must be tested by a head of water extending to the highest point of the filling pipes or 12 ft. above the load-line, or 12 ft. above the highest point of the compartment, whichever of these is the greater.

3. If peak tanks or other deep tanks are used for carrying liquid fuel, the riveting of these should be as required in the case of vessels carrying in bulk. The strengthening of these compartments must be to the Committee's satisfaction.

4. Each compartment must be fitted with an air pipe, to be always open, discharging above the upper deck.

5. Efficient means must be provided by wells and sparring or lining to prevent any leakage from any of the oil compartments from coming into contact with cargo or into the ordinary engine-room bilges.

6. If double bottoms under holds are used for carrying liquid fuel, the ceiling must be laid on transverse battens, leaving at least 2 ins. air space between the ceiling and tank top and permitting free drainage from the tank top into the limbers.

7. The pumping arrangements of the oil fuel compartments and their wells must be absolutely distinct from those of other parts of the vessels and must be submitted for approval. (If it is intended to sometimes carry oil and sometimes water ballast in the various compartments of the double bottom of the valves controlling the connection between these compartments and the ballast donkey pump, and also those controlling the suctions of the special oil pump, must be so arranged that the suctions for each separate compartment cannot be connected at the same time to both pumps.)

8. No wood fittings or bearers are to be fitted in the stokehold spaces.

9. Where oil fuel compartments are at the sides of or above, or below the boilers, special insulation is to be fitted where necessary to protect them from the heat from the boilers, their smoke boxes, casings, etc.

10. If the fuel is sprayed by steam, means are to be provided to make up for the fresh water used for this purpose.

11. If the oil fuel is heated by a steam coal the condensed water should not be taken directly to the

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condenser, but should be led into a tank or an open funnel mouth, and thence led to the hot well or feed tank.

12. The above arrangements are applicable only to the case of oil fuel, the flash point of which, as determined by Abel's close test, does not fall below 150° F.

The foregoing alterations and amendments also apply to the rules for iron vessels.

Subjoined is a translation of the latest circular issued by the Suez Canal Company with reference to the new rules for ships laden with petroleum in bulk and other products of that nature :—

SUEZ MARITIME CANAL UNIVERSAL COMPANY WORKING DEPARTMENT.

Regulations for the Navigation for Ships laden with Petroleum Oil in Bulk.

Any ship laden with petroleum oil in bulk, arriving before any port of access to the canal, must make herself known by flying at the mizzen one of the following signals :—

By day : A red flag above one ball.

By night : A white light beneath two red ones.

When the ship goes through the canal she must keep the above signals flying during the whole of her transit.

Before the ship enters the canal the captain must sign and hand to the officials of the company one of the two declarations herewith :

1. Declaration A, if the ship's cargo is composed exclusively of petroleum oil having a flash point below 23° C. (73° F.).

2. Declaration B, if the ship contains any products, whether petroleum or by-products of petroleum, such as gasoline, benzine, etc., having a flash point below 23° C. (73° F.).

In this latter case the ship has to comply with the following special regulations :

1. The ship must be under tow of one of the company's tugs during the whole of her transit through the canal ;

2. The ship is prohibited from navigation at night.

Declaration A.

This declaration gives a form to be signed by the captain, specifying the name, tonnage, etc., of the vessel, as well as her special registry class, and then proceeds :—

No single tank in the ship has a cubic capacity greater than 500 tons measurement (being tons of 2·83 cubic metres, or 100 cubic ft. English) nor can discharge its contents into any adjoining tank through any aperture or want of continuity whatever of its walls.

The petroleum oil contained in her tanks is solely refined petroleum of an uniform quality, no sample of which, taken at the port of loading, shall have a given flashing point below 23° C. (73 degrees Fahrenheit's. thermometer), this temperature having been ascertained comformably with such process of close test as may be recognised and made use of in the petroleum oil trade, as, for instance, the Abel test or any other close test of a not lesser degree of accuracy.

No part of the ship other than her tanks contains any products, whether petroleum, or by-products of petroleum, such as gasoline, benzine, etc., having a flash point below 66° C. (150° F.), tested as prescribed in the preceding paragraph.

Declaration B.

This declaration is on the same lines as Declaration A, but refers to petroleum products with a lower flash point than 23° C. The statement includes the following :—

No single tank in the ship has a cubic capacity greater than 2·83 cubic metres (or 100 cubic ft. English) nor can discharge its contents into any adjoining tank through any aperture or want of continuity whatever of its walls ;

All products having a flash point below 66° C. (150° F.)—this temperature having been ascertained conformably with such process of close test as may be recognised and made use of in the petroleum trade, as, for instance, the Abel test or any other close test of a not lesser degree of accuracy—are contained in the ship's tanks ;

The ship has aboard non-dangerous matters (water, coal, liquid fuel, etc.) admitting of easy unloading, in such quantity as shall suffice, in case of need, and at any time during her transit, to reduce the ship's draught by 1 ft. 8 in. by unloading same. . . .

The ship shall be provided, during the whole of her transit, with two mooring boats in constant readiness to be instantly availed of.

NEW YORK.

Regulations governing Vessels lying in Petroleum Docks in the Counties of New York, King's, and Queen's.

Captain must report arrival of vessel. No fires or lights are allowed on board without written permission

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of the wharfinger, who will supply cooking conveniences. No fires, smoking, or lights of any kind allowed on boats or vessels—except steam tugs and fire engines in the discharge of their duties—lying within 150 ft. of any place where petroleum, or its products, is kept for export, or in quantities exceeding 10,000 gallons, unless by permission in writing of the owner, lessee, or superintendent of such store, specifically stating the kind of light or fire, and the purpose and place for which it is required.

Port of New York Harbour Master's Regulations.

These rules relate to the position of vessels lying at wharves, and, generally, to the control of vessels while in the port, without particular reference to petroleum ships. The heating of pitch, tar, or other combustibles on board vessels lying at wharves, etc., in New York or Brooklyn, is prohibited.

AUSTRIA. (TRIESTE.)

Regulations of the Petroleum Harbour at S. Sabbia, 1891.

Tank steamers have precedence over all vessels for stations in the harbour, and rank amongst themselves in the order of their arrival. Sailing vessels or other steamers, lying at the wharf for loading or unloading barrels or cases, must give place to tank steamers when required. Vessels must be so moored that they can be cast loose. No reduction may be made in the number of hands on board until unloading is completed and the vessel has left her moorings. Tank steamers may use steam pumps, worked by steam from the boilers, for unloading; other steamers may use cranes or winches for the same purpose, provided the boiler for generating the steam is in the usual boiler room. The only light allowed on board petroleum vessels is that approved by the Harbour Authorities. On steamers, a lamp is allowed in the galley, and cooking may be done on board if water is kept at hand for use in case of fire; but for sailing vessels, the cooking must be done on shore in an appointed spot, unless the Harbour Officials are satisfied that it may be safely conducted on board. No stoves may be lighted so long as the vessel remains alongside the wharf. Smoking is forbidden, both on board and within the limits of the petroleum stores on shore. Unloading or loading must proceed at the rate of 400 barrels, at least, per diem, Sundays and bad weather excepted. For this purpose, five cases are considered as the equivalent of one barrel. The oil must be taken away by the consignees as it is landed. Admission to the petroleum stores is only allowed under special permission in the case of private persons not working therein. Foremen must be provided to superintend by day and night, and it is part of the foreman's duty to see, after the cessation of work for the day, that all lights and fires are properly extinguished. Pumping out steamer tanks between sunset and sunrise is only allowed in exceptional cases, and by the special permission of the harbour authorities, and similar permission is necessary for the filling of tank cars, barrels, or cases. The storage of full or empty cases or barrels, or of easily inflammable substances, in the open, is forbidden. In sheds and boiler houses, a supply of water must be kept at hand, in case of fire, together with hand pumps strong enough to force a jet up to the ceiling. No fuel or inflammable substances may be placed on boilers or near the fire doors. So long as the boiler is in use, a qualified person must be present in the boiler room, and the pumps and boilers may only be left unattended when all fires and lights are extinguished. The soldering of petroleum tins may only be effected in a place set apart by the authorities, containing a plentiful supply of sand or ashes and shovels ready to hand. No open light is allowed in the precincts of the stores, nor are petroleum lamps allowed in closed rooms.

Regulations of the Captain of the Port, May 15th, 1879.

Petroleum may be loaded in small quantities, and under the supervision of the Harbour Authorities, into lighters in the old port. Such boats, having petroleum on board, must remove from the shore at sundown, or if prevented by bad weather from so doing, must be guarded by a watchman. No fires, open lights, or smoking allowed while petroleum is on board. All petroleum lying on the quay, waiting to be loaded, must be under guard, but can only be allowed to so remain under exceptional circumstances. Steamers of the Austro-Hungarian Lloyd Company, lying at the quays, are allowed to take petroleum on board, provided this is effected on the day of departure and completed by sunset, and that the vessel is under the surveillance of two watchmen, as in the case of lighters detained at the quay.

The Danube.

The increasing traffic of kerosene and benzine carrying tank vessels between Passau and Ratisbon

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and the inflammability of the products carried have led the Austrian Ministry of the Interior to issue special police regulations with reference to the transport, lighterage, and unloading of tank vessels on the Danube. The greater part of the oil, largely of Roumanian origin, is transhipped at Passau into smaller tankers, which generally go up as far as Ratisbon, where their cargoes are discharged into huge storage installations.

According to the latest regulations, crude petroleum and its products may only be carried in bulk on the Danube if the specific gravity at 17·5° C. exceeds ·680. The tanks must not be filled up beyond 98 per cent. of their respective capacity. On these vessels fires and naked lights are not allowed and smoking is a punishable offence. The regulations prohibit the use of engine fires, but there is no objection to the benzine motors fitted with electric ignition and adequately water-jacketted. In order to render oil-carrying vessels more conspicuous, the river laws stipulate that they must have above the water line a 30 centimetre wide pale blue belt of paint. At least six "Labbosch" fire extinguishing grenades must be carried on each vessel while she is being towed, and no other vessel is allowed to steam close astern. In the river, as well as on the banks, tankers must not load, lighter, or unload except at points allotted by the river police, and it is stipulated, in addition, that, except in case of accident, such vessels must not moor or anchor less than 50 metres from inhabited places.

GERMANY. (BREMEN.)

Loading, Landing and Storage of Petroleum and Solar Oil.

Masters of vessels arriving are to give notice to the Harbour Authorities, stating what quantities of crude or refined oils are on board, and to moor their vessels according to directions. No loading, discharging, or removal of petroleum vessels is allowed without special permit. Fires, lights, and smoking are prohibited on petroleum vessels.

PORT OF BREMERHAVEN.

Harbour Board Regulations for the Discharging, Loading, and Storing of Petroleum and Solar Oil.

Vessels carrying these oils will, as a rule, and provided that their admission is consonant with the harbour regulations, be allowed to enter the Kaiserhafen only. The captain must report to the Harbour Authorities the nature of his cargo, and the number of barrels which it comprises, before entering the dock, the maximum penalty for omission being 20 marks per barrel. Watchmen are appointed, at the ship's expense, to ensure the absence of all lights, fires, and matches, and to prevent smoking. Cargo must be discharged immediately the ship is at the berth, care being taken to avoid blocking up gangways on board or on shore. Storage is effected in the manner prescribed by the regulations of September 18th, 1874. Vessels loading must leave immediately the cargo is all on board. Vessels discharging must be thoroughly cleansed, dunnage wood stored or disposed of by direction of the Harbour Authorities, and all rubbish taken ashore at once. The Harbour Authorities are empowered, in certain circumstances, to refuse admittance to the harbour, or to expel from the harbour ships already admitted, and to impose fines for breaches of these regulations.

For tank steamers importing petroleum in bulk, the following regulations are in force:—

Tank steamers about to discharge their cargo in the Kaiserhafen with their own steam must get up steam in the roads. In putting out the boiler fire, it must not be raked out on to the floor-plate, but allowed to burn out in the fire-box. Sampling the oil and driving out the vapour from the tanks must be carried out in presence of the official watchman, and in the roads. While the vessel is in the Kaiserhafen, no tank hatches may be unscrewed, except of those tanks actually being pumped out, and these covers must only be raised sufficiently to admit air for the prevention of rarefaction in the tank. Hatchways may only be completely open during daylight, and when the tanks are empty, and the covers must be replaced without loss of time. The boiler arrangements must conform to the Imperial Regulations, and be open to examination by the inspector of boilers. The pump boiler chimneys must be provided with spark catchers. Due notification to the authorities of the arrival of a tank steamer is compulsory, and the consignee is responsible for the conveyance of the necessary watchman on board while the vessel is lying in the roads.

HAMBURG.

Vessels carrying crude petroleum and its lighter products, refined petroleum, or turpentine, must report on arrival to the officer of the guardship at

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the Ionas, and a declaration must be made by the captain of the quantities he has on board. Ships having crude oil or the lighter products on board must anchor at a safe place in the lower part of the Elbe, near Twielenfleth, and may only discharge with the sanction of the Harbour Police Authorities, and under conditions imposed by them. Vessels laden with refined petroleum or turpentine may discharge in the petroleum harbour only. No lights or fires, are allowed on board, no smoking is permitted, and the hatches must be kept open to prevent the accumulation of explosive vapour.

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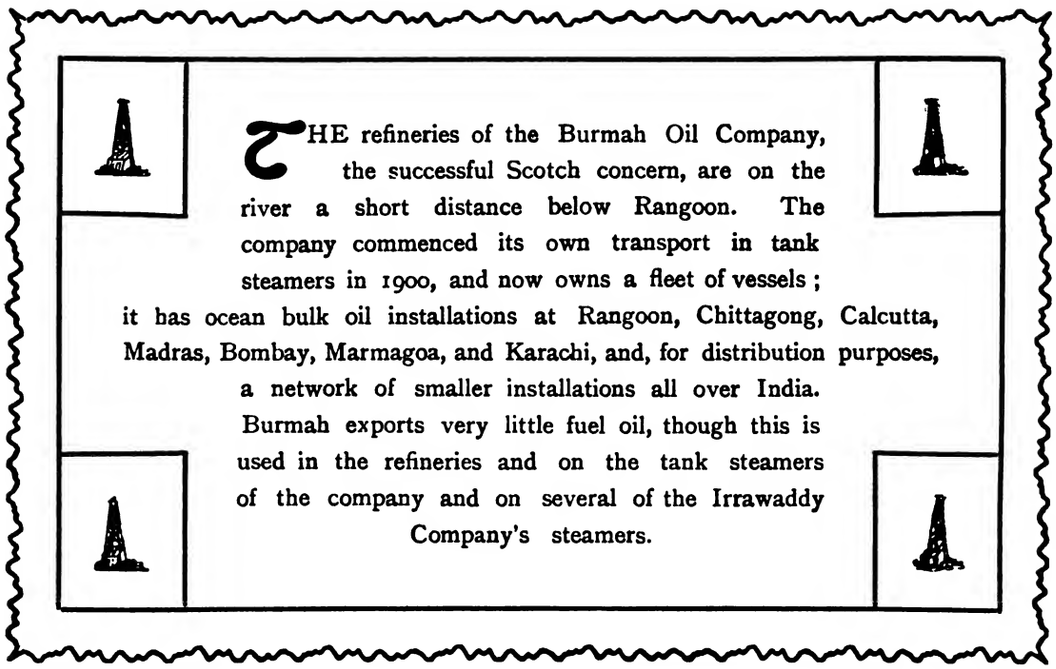

THE refineries of the Burmah Oil Company, the successful Scotch concern, are on the river a short distance below Rangoon. The company commenced its own transport in tank steamers in 1900, and now owns a fleet of vessels; it has ocean bulk oil installations at Rangoon, Chittagong, Calcutta, Madras, Bombay, Marmagoa, and Karachi, and, for distribution purposes, a network of smaller installations all over India. Burmah exports very little fuel oil, though this is used in the refineries and on the tank steamers of the company and on several of the Irrawaddy Company's steamers.

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LATE INFORMATION.

Messrs. Peter Wright & Sons and the Elizabeth Watts. New Tank Steamers; orders for eighteen.

I RECEIVED, as recently as August 15th, an interesting communication from Messrs. Peter Wright & Sons on the subject of the first cargo of petroleum transported across the ocean. It refers to the voyage of the oil-carrying brig *Elizabeth Watts* to this country in 1861 (see first page of Chapter I.). Along with the letter the company sent a photographic facsimile of the original charter party ("struck off from our plate for the purpose of complying with your request," says the writer of the letter), and I very much regret that time does not permit me to give anything more than the following type reproduction of the interesting document:—

(*Copy of the first charter party for the Ocean Transport of Petroleum.*)

PETER WRIGHT & SONS,
SHIPPING AND COMMISSION MERCHANTS,
No. 115, WALNUT STREET, PHILADELPHIA.

This charter party, made and concluded upon in Philadelphia, the 12th day of November, in the year one thousand eight hundred and sixty one, between Capt. Charles Bryant, master and agent for owners, of the brig *Elizabeth Watts* of Camden, of the burthen of 224 tons, or thereabouts, register measurement, now lying in the harbour of Camden of the first part, and Peter Wright & Sons, merchants, of the second part, witnesseth, that the said party of the first part, for and in consideration of the covenants and agreements hereinafter mentioned, to be kept and performed by the said parties of the second part, doth covenant and agree on the freighting and chartering of the said vessel unto the said parties of the second part, for a voyage from Philadelphia to London, England, vessel to proceed to Shippen St. wharf at once on the terms following, that is to say, dangers of the sea excepted:—

First—The said party of the first part doth engage that the said vessel, in and during the said voyage, shall be kept tight, staunch, well-fitted, tackled and provided with every requisite, and with men and provisions necessary for such voyage. Second—The said party of the first part doth further engage that the whole of said vessel (with the exception of the cabin and the necessary room for the accommodation of the crew and the stowage of the sails, cable, and provisions) shall be at the sole use and disposal of the said parties of the second part during the voyage aforesaid; and that no goods or merchandise whatever shall be laden on board, otherwise than from the said parties of the second part, or their agent, without their consent, expressed in writing. Third—The said party of the first part doth further engage to take and receive on board the said vessel, during the aforesaid voyage, all such lawful goods and merchandise as the said parties of the second part, or their agents, may think proper to ship.

And the said parties of the second part, for and in consideration of the covenants and agreements to be kept and performed by the said party of the first part, do covenant and agree, with the said party of the first part, to charter and hire the said vessel as aforesaid, on the terms following, that is to say:—

First—The said parties of the second part do engage to provide and furnish to the said vessel a full and complete cargo of rock oil in barrels. Second—The said parties of the second part do further engage to pay to the said party of the first part, or the agent, for the charter or freight of the said vessel during the voyage aforesaid, in manner following, that is to say: eight shillings sterling per barrel delivered with 5 per cent. primage, payable cash on right delivery of cargo without discount. Vessel to take bills of lading in settlement of this charter. It is further agreed between the parties to this instrument, that the said parties of the second part shall be allowed for the loading and discharging of the vessel at the respective ports aforesaid, lay days as follows—that is to say: ten working days for loading, and twelve working days in London for discharging, and in case the vessel is longer detained, the said parties of the second part agree to pay to the said party of the first part, demurrage at the rate of twenty-five dollars

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per day, day by day for every day so detained, provided such detention shall happen by default of the said parties of the second part, or their agent.

It is also further understood and agreed that the cargo or cargoes shall be received and delivered at the ports of loading and discharging according to the custom. Vessel to employ charterer's stevedore at customary rates. Vessel to be consigned to charterer's friends at London, paying them 2½ per cent. commission on amount of charter. It is understood and agreed that a commission of 5 per cent. on amount of charter is due Peter Wright & Sons on the signing of this charter. To the true performance of all and every of the foregoing covenants and agreements, the said parties, each to the other, do hereby bind themselves, their heirs, executors, administrators, and assigns (especially the said party of the first part, the said vessel, her freight, tackle, and appurtenances, and the said parties of the second part, the merchandise to be laden on board), each to the other in the penal sum of estimated amount of freight.

In witness whereof, the said parties have hereunto interchangeably set their hands,

CHARLES BRYANT.
PETER WRIGHT & SONS.

Delivered in presence of
THEODORE WRIGHT.
C. A. GRISCOM.

(The company's present address is 318½, Walnut Street, Philadelphia, while the New York office is at Morris Building, Broad and Beaver Streets, and the representatives in this country are Messrs. Hill & Cassap, 8, 9, and 10, Great St. Helens, E.C.)

* * * * *

Prior to the time mentioned, and for quite a number of years, Messrs. Peter Wright & Sons had been shipping out of Philadelphia, over their sailing vessel lines to Liverpool, London, etc., small parcels of twenty-five to fifty barrels of refined petroleum. The barrels were stowed forward of the fore hatch, where, in case of leakage, the oil could not injure any of the general cargo.

Against the 8*s.* freight paid in 1861 for small parcels, 12*s.* 6*d.* was frequently paid, and in the case of the *Elizabeth Watts* it will be noticed that she carried 1,329 barrels.

In recent years the rate of freight has declined to 1*s.* 9*d.* per barrel, but the size of the cargoes has increased to 3,500,000 gallons in a single craft, equal to, say, 87,500 payable barrels.

An interesting feature of the charter party is that it was witnessed by a young clerk—C. A. Griscom—who subsequently (in 1870) was the prime mover in the construction of the first tank steamers—the *Vaderland* and her associates—intended to carry liquid cargoes across the Atlantic.

* * * * *

At the end of August it was known that orders for eighteen new tank steamers had been given out. Messrs. Balfour, Williamson & Co. added another to the two with which they are credited in my estimate (page 149), while Mr. Gukassov (one of the principals of the great Baku oil-producing and refining house, and connected with the Homelight Oil Company, of London) placed an order for the earliest possible delivery of an oil-carrier of 7,000 tons. The two vessels referred to are being built by Messrs. Armstrong, Whitworth & Co.

Others desirous of securing new tonnage are waiting for a drop in the shipbuilders' prices, and further orders are certain to be placed before the end of the year.

* * * * *

I hear that the *Iroquois* and several other new steamers intended for the American oil trade will be equipped with Howden's well-known patent forced draught, which has proved so successful in all types of steamers, considerably over 2,300 steamers now being fitted with this system. It is adapted in the case of these steamers for burning either coal or oil fuel.

* * * * *

I have received the latest available information about the oil-carrying shipping business of Russia. This includes a table showing the number of bulk oil vessels (steamers) employed on the Baltic, Black, and Caspian Seas:—

	Baltic Sea.	Black Sea.	Caspian Sea.
1896	2	4	89
1897	2	4	91
1898	2	4	102
1899	2	4	128
1900	2	4	129
1901	2	5	127
1902	2	6	128
1903	2	6	132
1904	2	7	133
1905	2	7	129
1906	2	8	131
1907	2	6	128

These figures are official, but they differ from those produced by Baku authorities, who do not agree as to the numbers in any single year.

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I am told that at the beginning of this year the oil-carrying sailers on the Caspian numbered 166 (48,975 tons capacity).

The following table shows the countries in which the tank steamers of the Caspian were built :—

	England.	Russia.	Germany.	Sweden.
Up to 1896	8	33	37	—
In 1896	—	—	1	—
„ 1897	7	2	3	5
„ 1898	2	7	1	6
„ 1899	2	—	3	—
„ 1900	—	—	—	—
„ 1901	—	2	—	—
„ 1902	—	3	1	—
„ 1903	1	3	2	1
„ 1904	—	—	—	—
„ 1905	—	1	—	—
	—	—	—	—
Total	20	51	48	12

From 1882 up to the present time twenty-eight tank steamers have been built in this country to trade under the Russian flag. One of the Russian-built vessels launched in 1902, the year in which peace was declared in South Africa, was christened the *President Kruger*.

The following are the largest owners of tank steamers on the Caspian :—Nobel, 12 ; M. B. Ousseinoff, 6 ; Société d'Orient, 6 ; G. A. Dadacheff, 6 ; Mazout, 6 ; Zak-Naroff and Skrepinsky, 4 ; Ch. A. Dadacheff, 5 ; Rassouloff, 4 ; and Kachtchéeff, 5.

Below I give a table showing the fluctuations in the rates of freight earned by the bulk oil-carriers trading between Astrakhan and the following ports :—

	Distance in Kilometres.	Copecks.					
		1906.	1905.	1904.	1903.	1902.	1901.
Tzaritzin... ...	504	1·0	1·0	0·92	0·8	1·75	1·1
Saratov	935	2·30	1·90	1·75	1·6	2·4	2·38
Samara	1,398	3·45	2·94	2·78	2·50	3·6	3·15
Kazan	1,883	4·5	4·0	3·7	3·25	4·7	4·4
Nizhni-Novgorod	2,319	5·75	4·75	4·6	4·00	5·50	5·38
Jaroslawl ...	2,740	6·8	5·75	5·5	4·85	6·7	6·5
Rybinsk	2,834	7·1	5·9	5·75	5·00	7·0	6·9

At the end of the month in which this book is published one of the most important oil contracts ever entered into will come to an end ; I refer to the one made some eight years ago between the Gulf (late Guffey) Refining Company and the Anglo-Saxon Petroleum Company (late Shell Transport and Trading Company), which gave the last-named concern first claim on all oil shipments to this country. This has always been a good contract for the British company, which, I should estimate, has received from the refineries of the Gulf Company an average of 70,000 or 80,000 tons of oil a year, or, roughly, 600,000 tons on the contract. With the termination of the contract the large steamers of the Anglo-Saxon Company will call less frequently at Port Arthur, but this does not mean there will be a diminution in the quantity of oil shipped by the Gulf Company to this country, because (I am able to state on good authority) a new contract has been made with the British Petroleum Company (the General-Consolidated combination) working in conjunction with what is known as the European Petroleum Union. This arrangement will result in a number of new steamers being placed in the Anglo-Texas oil trade. While the Shell steamers loaded Texas oil, I understand those of the British Petroleum Company will bring away Indian Territory oil pumped to tide-water and there refined by the Gulf Company.

* * * * *

On page 74 I refer to a new system of framing for oil-carrying vessels invented by Mr. Isherwood. I am pleased to conclude this work with the announcement that, leaving Lloyd's Register, he has just become an active director of the old-established firm of Messrs. Craggs and Sons, the Middlesbrough builders of a number of tank steamers. Messrs. Craggs and Sons will not exclusively build the Isherwood type of vessel, but it may be taken for granted that his presence on the board means that the construction of tank steamers on his new model will be encouraged and advanced.

Bradbury, Agnew & Co. Ld., London and Tonbridge. (2702—9-07.)

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HOLZAPFEL'S

Anti-Corrosive & Anti-Fouling Compositions

ARE THE BEST.

SPECIALITY FOR PETROLEUM INSTALLATIONS:

HOLZAPFEL'S PETROLEUM RESISTING COMPOSITION.

REGISTERED  TRADE MARK.

Shell Steamers VOLUTE (on the left) and ELAX (on the right) in Dock at Genoa, being coated with HOLZAPFEL'S INTERNATIONAL COMPOSITION.

As used by—

M. SAMUEL & CO., ASIATIC PETROLEUM CO., LTD.,
KON. NEDERL. STOOMBOOT MAATS.

HOLZAPFEL'S COMPOSITIONS Co., LTD.,

HEAD OFFICE: NEWCASTLE-ON-TYNE.

BRANCHES:
42, MOUNT STUART SQUARE, CARDIFF,
36, CHAPEL STREET, LIVERPOOL,
12, WATERLOO STREET, GLASGOW,
57, FENCHURCH STREET, LONDON.

ALSO AT
WEST HARTLEPOOL, SUNDERLAND, HULL,
NEW YORK, HAMBURG, COPENHAGEN,
GENOA, SEBASTOPOL, &c.

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SMITH'S DOCK Co., LTD.,

Amalgamated in 1899 with H. S. EDWARDS & SONS.

Head Office: HIGH DOCKS, SOUTH SHIELDS.

. And at .

Guildhall, Newcastle-on-Tyne.
17, Gracechurch Street, London.

. Telegraphic Address .

SMITH'S, North Shields.
EDWARDS, South Shields.

DOCK OWNERS, SHIPBUILDERS,

Engineers, Boiler Makers,
Brass Founders, Copper-Smiths, &c.

EIGHT LARGE DOCKS & PONTOONS,

Situated close to the River Mouth and all the Principal Loading Docks.

Important Alterations and Extensions in progress.

SPECIAL ATTENTION given to REPAIRS and ALTERATIONS to

OIL TANK STEAMERS.

VESSELS CONVERTED FOR BURNING OIL FUEL.

All Docks are fitted with Portable Electric Lamps and Special Pumps for the rapid Filling and Testing of

OIL TANKS.

A Large Staff of Men, specially trained and constantly employed on Oil Work, always available.

VIEW OF THE INTERIOR OF THE FITTING SHOP,
EQUIPPED WITH THE MOST MODERN MACHINERY AND APPLIANCES.

A World's Record in the Docking of Tank Steamers.

The following is a list of the Tank Steamers docked by Messrs. Smith's Dock Company, Ltd.

1889.

October	..	Rocklight
November	..	Kasbek

1890.

January	..	Darial
,,	..	Lumen
February	..	Elbruz
March	..	Darial
June ..	..	Lumen
,, ..	..	Darial
July ..	..	Rocklight
August	..	Kasbek
,,	..	Darial
November	..	Lumen

1891.

March	..	Kasbek
May ..	..	Energie
April ..	..	Elbruz
,, ..	..	Astral
May ..	..	Geestemunde
,, ..	..	Kasbek
July ..	..	Elbruz
September	..	Darial
November	..	,,

1892.

January	..	Kasbek
,,	..	Elbruz
,,	..	,,
May ..	..	Darial
August	..	Aral
,,	..	Elbruz
September	..	Astral
November	..	Tancarville
December	..	Darial

1893.

February	..	Elbruz
March ..	..	Broadmayne
,, ..	..	Kasbek
April ..	..	Astrakhan
,, to June		Lucerna
June ..	..	Bakuin
,, ..	..	Lumen
July ..	..	Darial
August	..	Astral
,,		Lucigen
October	..	Weehawken
November	..	Astrakhan

1894.

January	..	James Brand
,,	..	Chigwell
,,	..	Elbruz
,,	..	Baku Standard
,,	..	Kasbek
February	..	Oriflamme
,,	..	Prudentia
,,	..	Astral
March ..	..	Darial
,, ..	..	Baku Standard
,, ..	..	Broadmayne
April ..	..	Lucerna
,, ..	..	Luciline
May ..	..	Azov
June ..	..	Suram
July ..	..	Elbruz
,, ..	..	Flax
,, ..	..	Duffield
August	..	James Brand
,,	..	Luciline
,,	..	Lucigen
,,	..	Euplectella
September	..	Petriana
November	..	Astrakhan
December	..	Lucerna
,,	..	Oriflamme

List of Oil Vessels Docked, &c.—*Continued.*

1895.

January	..	Lumen
,,	..	Manhattan
,,	..	Aral
,,	..	Luciline
,,	..	Petriana
,,	..	James Brand
February	..	Baku Standard
,,	..	James Brand
March ..	..	Prudentia
,, ..	..	Duffield
,, ..	..	Elbruz
April ..	..	Lumen
May ..	..	Bq. Lawhill
,, ..	..	Hotham Newton
,, ..	..	Suram
,, ..	..	Broadmayne
June ..	..	Batoum
,, ..	..	Christine
July ..	..	Oriflamme
,, ..	..	Lumen
August	..	Petriana
,,	..	Duffield
,, to Oct.		Weehawken
November	..	Aral
,,	..	Chigwell
,,	..	Prudentia
December	..	Basu Standard

1896.

January	..	Luciline
February	..	Chigwell
,,	..	Duffield
March ..	..	Aureole
,, ..	..	Suram
May ..	..	Luciline
June ..	..	Weehawken
,, ..	..	Duffield
July ..	..	Lumen
,, ..	..	Telena
,, ..	..	Prudentia
,, ..	..	Baku Standard
August	..	Azov
,,	..	Astral
,,	..	Petriana
September	..	Aureole
,,	..	Oilfield
,,	..	Christine
,,	..	Chigwell
October	..	Kasbek
November	..	Oilfield
December	..	Duffield

1897.

January	..	Luciline
,,	..	Weehawken
,,	..	Manhattan
February	..	Vedra
,,	..	Baku Standard
,,	..	Prudentia
,,	..	Weehawken
March ..	..	St. Helens
,, ..	..	Broadmayne
,, ..	..	Elbruz
,, ..	..	Astrakhan
,, ..	..	Aral
,, ..	..	Aureole
,, ..	..	Lucigen
,, ..	..	Astral
April ..	..	Kura
,, ..	..	Aral
June ..	..	Duffield
,, ..	..	Aureole
July ..	..	Darial
,, ..	..	Petriana
,, ..	..	Duffield
,, ..	..	Lucerna
,, ..	..	Azov
August	..	Astrakhan
,,	..	Batoum
September	..	James Brand
,,	..	Oilfield
,,	..	Aureole
October	..	Luciline
,,	..	Chigwell
,,	..	Delaware
,,	..	Baku Standard
November	..	Elbruz
,,	..	Aral
December	..	Duffield

1898.

January	..	Beacon Light
,,	..	Aras
,,	..	Phosphor
,,	..	Rion
,,	..	Circassian Prince

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Smith's Dock Company

Is the modern representative of two of the oldest and best known firms of the kind founded during the Eighteenth Century. Commenced by MR. THOMAS SMITH, the business of **Messrs. Smith's Company,** which embraced everything connected with the maritime industry, was carried on continuously by members of the family until the present Company, which includes the firm of MESSRS. H. S. EDWARDS & SONS (founded in 1768), was formed.

The Machinery and Appliances of the Docks, Pontoons and Workshops are of the most modern and complete description.

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The Shipyard, like the Docks, is complete in every department; the Shops and Sheds being provided with all the latest Machinery driven by Steam, Hydraulic and Electric Power, the latter being generated in the Company's own power station.

The yard is partially covered, and the present space admits of the building of vessels of large size.

The Store Rooms contain everything required in the business of Ship-building and Ship-repairing, so that there is no delay in the execution of the work in hand, whatever its character.

Vessels are equipped to burn Oil Fuel and adapted to carry Creosote.

SOME OF THE COMPANY'S DOCKS.

List of Oil Vessels Docked, &c.—*Continued.*

1893—*Continued.*

February	..	St. Helens
,,	..	Broadmayne
March ..	..	Lucilne
,, ..	..	Aras
,, ..	..	Weehawken
April ..	..	St. Helens
,, ..	..	Kasbek
,, ..	..	Duffield
,, ..	..	Aral
May ..	..	Darial
,, ..	..	Titian
,, ..	..	Lucerna
,, ..	..	Lackawanna
,, ..	..	Kura
,, ..	..	Rion
June ..	..	Baku Standard
,, ..	..	Aureole
,, ..	..	Azov
,, ..	..	Vedra
July ..	..	Duffield
September	..	Baku Standard
,,	..	James Brand
,,	..	Elbruz
November	..	Oilfield
,,	..	Aral
December	..	Minoco
,,	..	Astrakhan
,,	..	Duffield
,,	..	Lucerna

1899.

January	..	Baku Standard
,,	..	Aureole
,,	..	Aral
February	..	James Brand
,,	..	Batoum
March ..	..	Lucigen
April ..	..	2 Oil Barges
,, ..	..	Vedra
,, ..	..	Broadmayne
,, ..	..	Elbruz
May and July		Tancarville
,, ..	..	Kasbek
,, ..	..	Aras
June ..	..	Astrakhan
,, ..	..	Aral
July ..	..	Oranje Prince
,, ..		Azov
,,	..	Oilfield
August	..	Duffield
,,	..	Weehawken
,,	..	Darial
,,	..	James Brand
September	..	Batoum
,,	..	Tancarville
,,	..	Prudentia
,,	..	Lucigen
October	..	Aureole
,,	..	Broadmayne
November	..	James Brand
December	..	Geestemunde
,,	..	Astrakhan
,,	..	Rion
,,	..	Elbruz
,,	..	Lucigen

1900.

Jan. to Feb.	..	Geestemunde
,, ..	..	Energie
,, ..	..	Kura
,, ..	..	Energie
,, ..	..	Astrakhan
February	..	Saxoleine
March ..	..	Vedra
,, ..	..	Aras
,, ..	..	Aral
,, ..	..	Volute
,, ..	..	Lucerna
April ..	..	Balakani
,, ..	..	Lucilne
,, ..	..	Mexican Prince
,, ..	..	Minoco
,, ..	..	Oriflamme
,, ..	..	Astrakhan
,, ..	..	Lucilne
,, ..	..	Lucerna
May ..	..	Lucigen
,, ..	..	Azov
,, ..	..	Bloomfield
,, ..	..	Baku Standard
July ..	..	Tancarville
,, ..	..	Broadmayne
,, ..	..	Standard
,, ..	..	Gut Heil
,, ..	..	Terek
,, ..	..	Batoum
,, ..	..	James Brand
,, ..	..	Vedra
,,	..	Genesee
September	..	Mannheim
,,	..	Saxoleine
October	..	Lucigen
,,	..	Aureole
,,	..	Delaware
,,	..	Aral
December	..	Genesee
,,	..	Bloomfield
,,	..	Duffield

1901.

January	..	Geestemunde
,,	..	Lucerna
,,	..	Lumen
,,	..	Burgermeister Petersen
,,	..	Brilliant
,,	..	Lumen
February	..	Balakani
,,	..	Gut Heil
,,	..	Russian Prince
,,	..	Balakani
,,	..	Rion
March ..	..	Oilfield
,, ..	..	Lucilne
,, ..	..	Lucerna
,, ..	..	Astrakhan
,, ..	..	James Brand
,, ..	..	Aral
,, ..	..	Tancarville
,, ..	..	Oriflamme

List of Oil Vessels Docked, &c.—*Continued.*

1901—*Continued.*

April ..	..	Lucigen
,, ..	..	Northern Light
,, ..	..	Helios
May ..	..	Elbruz
,, ..	..	Tancarville
,, ..	..	Terek
,, ..	..	Lucigen
June ..	..	Elbruz
,, ..	..	Aureole
,, ..	..	Duffield
July ..	..	Genesee
,, ..	..	Northern Light
,,	..	Burgermeister Petersen
,, ..	..	Potomac
,, ..	..	Northern Light
,, ..	..	Ottawa
August	..	Ottawa
,,	..	Potomac
,,	..	Tioga
,,	..	Russian Prince
,,	..	Tioga
,,	..	Lucerna
,,	..	Saxoleine
,,	..	Hotham Newton
September	..	Tioga
,,	..	Russian Prince
,,	..	Aral
October	..	James Brand

List of Oil Vessels Docked, &c.—*Continued.*

1901—*Continued.*

October	..	Vedra
,, to Dec.		Minoco
November	..	Balakani
,,	..	Lucilne
,,	..	Suwanee
December	..	Saxoleine
,,	..	Oriflamme

1902.

January	..	Pure Oil
,,	..	Le Coq
,,	..	Oilfield
February	..	Lumen
,,	..	Suram
,,	..	Vedra
March ..	..	James Brand
,, ..	..	Lucerna
,, ..	..	Lucifer
April ..	..	Weehawken
May ..	..	Lucerna
,,	..	Balakani
,, ..	..	Lackawanna
June ..	..	Astrakhan
,, ..	..	Suwanee
,,	..	Potomac
July ..	..	Mira
,, ..	..	Oilfield
,, ..	..	Lumen

List of Oil Vessels Docked, &c.—*Continued.*

1902—*Continued.*

July ..	..	Broadmayne
August	..	Tuscany
,,	..	Saxoleine
September	..	Le Coq
,,	..	Azov
,,	..	Terek
October	..	Mannheim
,,	..	Lucerna
November	..	Aral
,,	..	Lucilne
December	..	Oranje Prince
,,	..	Tuscany
,,	..	Cymbeline

1903.

January	..	Astrakhan
,,	..	Mura
February	..	Ottawa
March ..	..	Genesee
May ..	..	Le Coq
June ..	..	Saxoleine
,, ..	..	Aral
,, ..	..	Broadmayne
,, ..	..	Pennoil
,, ..	..	Lucifer
,, ..	..	Suwanee
July ..	..	Lumen
,, ..	..	Rion
,, ..	..	Baku Standard

List of Oil Vessels Docked, &c.—*Continued.*

1903—*Continued.*

September	..	Vedra
,,	..	Balakani
,,	..	Lucilne
October	..	Kura
,,	..	Suwanee
,,	..	Turbo
,,	..	James Brand
,,	..	Pennoil
November	..	Aral
December	..	Oilfield

1904.

January	..	Lumen
,,	..	Henri Keith
,,	..	Housatonic
,,	..	Oranje Prince
February	..	Appalachee
,,	..	Aral
,,	..	Astrakhan
March ..	..	Saxoleine
,, ..	..	Lux
,, ..	..	Turbo
,, ..	..	Euplectela
April ..	..	James Brand
May ..	..	Broadmayne
June ..	..	Tonawanda
July ..	..	Genesee
,, ..	..	Oriflamme
,, ..	..	Aureole
August	..	Terek
September	..	Lux
October	..	Brilliant
,,	..	Weehawken
,,	..	Lumen
,,	..	Astrakhan
November	..	Aral
,,	..	Terek
December	..	Margaritha
,,	..	Lucilne

1905.

January	..	Tancarville
,,	..	Lucilne
,,	..	Astrakhan
February	..	Deutschland
,,	..	Tancarville
,,	..	Manhattan
March ..	..	Tancarville
,, ..	..	Broadmayne
,, ..	..	Baku Standard
April ..	..	Etelka
May ..	..	Weehawken
,, ..	..	Beacon Light
,, ..	..	Lackawanna
,, ..	..	Vedra
,, ..	..	Broadmayne
,, ..	..	Aral
June ..	..	Lumen
,, ..	..	Weehawken
,, ..	..	Oriflamme
July ..	..	Astrakhan
,, ..	..	Weehawken
,, ..	..	Batoum
,, ..	..	Beacon Light
August	..	Russian Prince
,,	..	Lucerna
,,	..	Housatonic
September	..	
November	..	Aral"
,,	..	Tioga
,,	..	Lackawanna
December	..	Mexican Prince

1906.

January	..	Graf Stroganoff
,,	..	Astrakhan
February	..	Aureole
March ..	..	Baku Standard
,, ..	..	James Brand
,, ..	..	Diamant
April ..	..	Vedra
,, ..	..	Broadmayne
,, ..	..	James Brand
,, ..	..	Baku Standard
May ..	..	Batoum
,, ..	..	Lux
June ..	..	Genesee
,, ..	..	Lucerna
July ..	..	Le Coq
,, ..	..	Willkommen
August	..	Chesapeake
September	..	Oriflamme
,,	..	Lucerna
,,	..	Aral
October	..	Astrakhan
,,	..	San Christobal
November	..	Oranje Prince
,,	..	Oilfield
,,	..	Aras
,,	..	Romany
,,	..	Rossija
December	..	Georgian Prince
,,	..	Lucilne

1907.

January	..	Broadmayne
,,	..	Lumen
,,	..	Astrakhan
February	..	Batoum
Feb. 3rd to Mar. 13th		Flax
February	..	Baku Standard
,,	..	Batoum
Feb. 27th to Mar. 2nd		Aral
February 24th		Housatonic
April ..	..	Euplectela
,, ..	..	Lumen

In addition to the vessels docked the Company have done a considerable quantity of other descriptions of work to oil-carrying vessels afloat.

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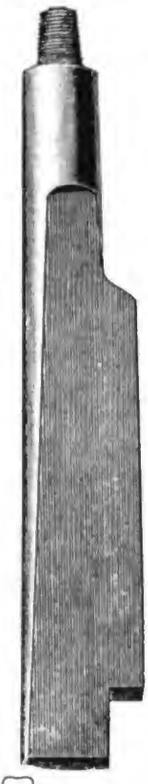

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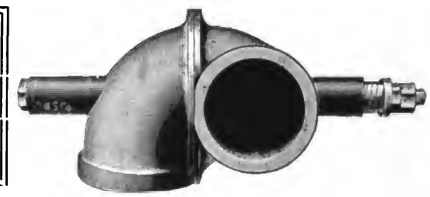

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The photographs from which these illustrations are produced were taken on December 25th, 1906, and show the work all but completed.

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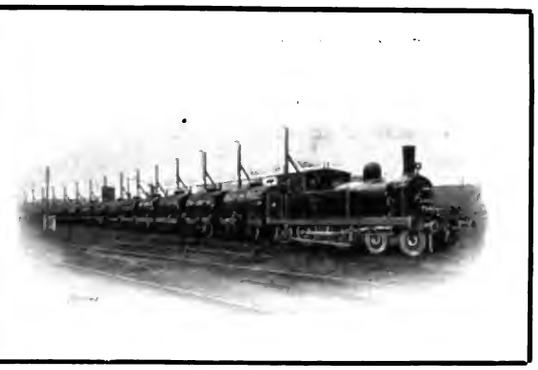

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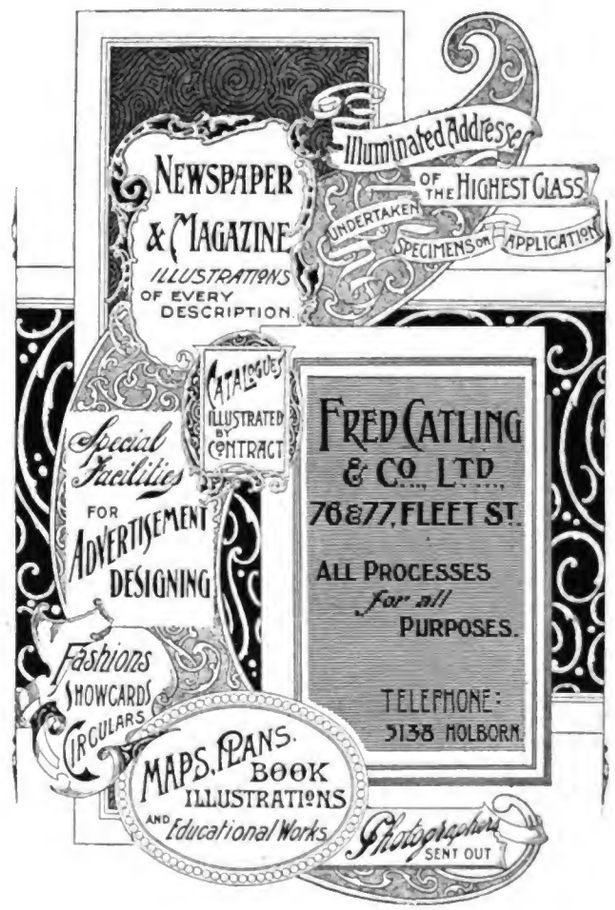

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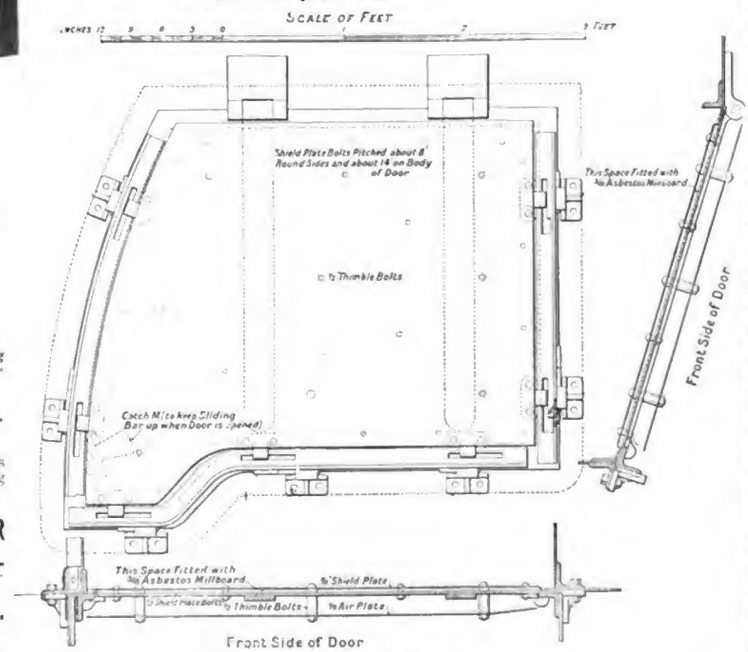

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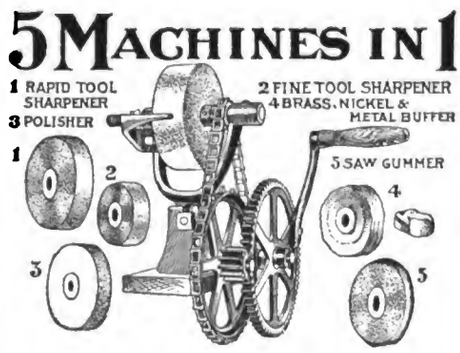

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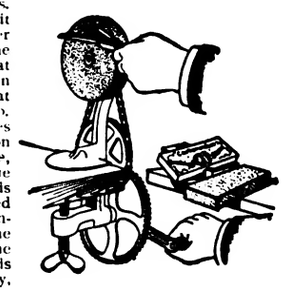

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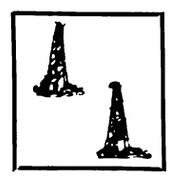

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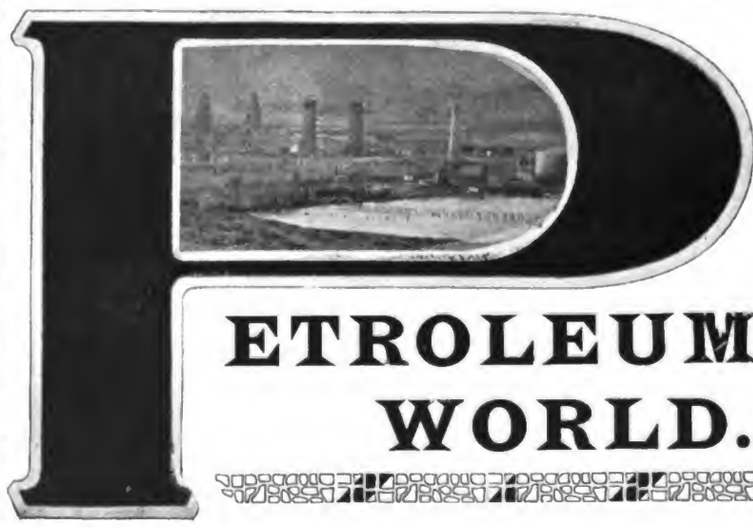

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A LAST WORD.

I AM writing this note on the day that the Third International Petroleum Congress finishes at Bucharest. Three months ago I refused an invitation to contribute a paper on the Marine Transport of Oil. I did so for two reasons. First of all, I am opposed to the presentation by proxy of papers contributed by absentees, and as I fully expected that business connected with this work and the journal which I control would keep me in this country during September I was reluctantly compelled to refuse.

I should say that my second reason is the more important of the two. I desired to keep my information exclusively for those who honour me by reading this work. Whatever weakness the book may have—and I am conscious that it has faults—I do not think anyone will say that it lacks originality; not only is the subject admittedly important, but it is entirely new, and, on this last day of the congress, I am not surprised to find that amongst the hundreds of speeches made and papers read not one touches on the subject of the maritime branch of the great business of oil transport and distribution. To this extent I break new ground in the literature of petroleum.

My many friends in all parts of the petroleum world will not require to be told that I have not been led to write this book for selfish or vain-glorious reasons: they, at any rate, will know that it is a humble attempt to truthfully tell the story of the growth of one of the leading branches of our industry: the fascinating one of the ships which carry the oil, the enterprising men who own them, and the reliable and brave men who navigate and work them.

AUTHOR.

September 14th, 1907.

EXPLANATORY NOTE.—The month given on the back of the title page—August—is the one in which the final proofs of the book proper were passed for the press. The pages of "Late Information," inserted while the book was on the machines, are supplementary.

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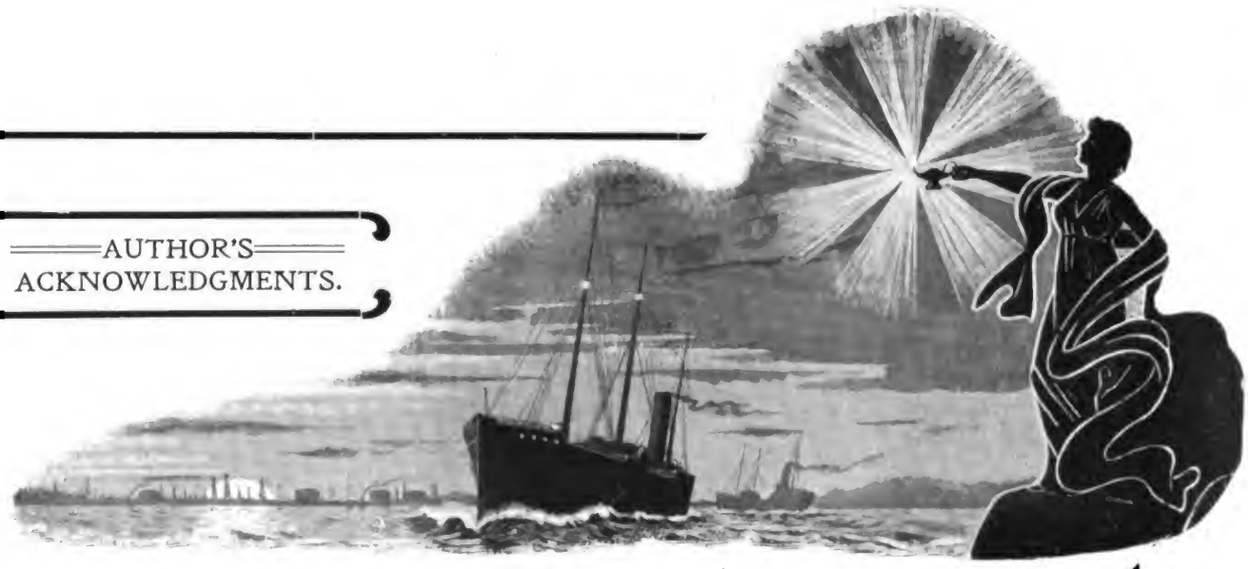

AUTHOR'S ACKNOWLEDGMENTS.

FOR assistance received and encouragement given, I am, first of all, under obligation to Mr. S. Gouli-chambaroff. I share his great faith in the early rejuvenation of the Russian oil business, and have long admired his broad-minded opinions on the most difficult petroleum subjects of the world's foremost producing countries.

Mr. Herbert J. Bult, F.C.S., one of the most able and conscientious of the younger school of specialists in petroleum chemistry, has given assistance in the compilation of technical information in Part III.

Mr. F. J. Trost, the most successful oil field artist I have met, holds the copyright of some of the best photographs which I reproduce.

Elsewhere I acknowledge having made quotations from an excellent technical work written by Mr. Herbert Little, of Liverpool, at a time when the earliest tank steamers were starting to run.

Otherwise, so far as individuals are concerned, I have thought it wise, this being a new subject on which very little has been published, to depend on my own numerous and widely-scattered professional sources of information.

* * * * *

My responsibilities in connection with the business side of this work have been reduced to a minimum by the generous support I have received for the advertisement section. I consider this is a case in which business is not inconsistent with good and impartial authorship, and I frankly acknowledge that it is owing to the advertisement pages that I am in a position to produce a work which, at the price charged, easily makes a record in the literature of this industry for typographical bulk and artistic finish.

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